FLIGHT and The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

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Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

COVENTRY:	BIRMINGHAM, 2:	MANCHESTER, 3:	GLASGOW, C.2:
8-10, CORPORATION ST.,	GUILDHALL BUILDINGS, NAVIGATION ST.	260, DEANSGATE,	26B, RENFIELD ST.,
Telegrams: Autocar, Coventry.	*Telegrams:* Autopress, Birmingham.	*Telegrams:* Iliffe, Manchester.	*Telegrams:* Iliffe, Glasgow.
Telephone: Coventry 5210.	*Telephone:* Midland 2971 (5 lines).	*Telephone:* Blackfriars 4412.	*Telephone:* Central 4857.

SUBSCRIPTION RATES: Home and Abroad: Year, £3 1 0. 6 months, £1 10 6. 3 months, 15s. 3d.
Registered at the G.P.O. as a Newspaper.

No. 1756. Vol. XLII. August 20th, 1942. Thursdays, One Shilling.

The Outlook

The Loss of H.M.S. Eagle

AIR CHIEF MARSHAL SIR ARTHUR LONGMORE has said (if we remember right) that the day of the aircraft carrier in the Mediterranean is past, and Admiral Sir Andrew Cunningham has laid it down that "when great distances are involved this weapon (i.e., naval aircraft) must be transported in carriers, but in confined spaces like the Mediterranean it can be shore-based, given suitable aircraft and technique." Despite the views of these two authorities, the Navy continues to use carriers in the Mediterranean, and H.M.S. *Eagle* has now been added to the tale of carrier losses. Incidentally, it was a submarine and not enemy aircraft which sank her.

Those two distinguished officers set up an ideal, but what is practicable does not always conform with the ideal. It is hard to see how the Navy can avoid using carriers in the Mediterranean at present. It must always be remembered that within its range the shore-based single-engined fighter dominates the skies, and that Malta must be kept supplied with that class. There seems no way of getting them there except in a carrier. Large freighter aircraft might solve the problem, but Britain is woefully short of that class. Moreover, long-range fighters from the shore cannot do all the protective work which a fleet needs. In the Mediterranean the fleet is constantly attacked by the enemy's shore-based aircraft, and it needs to have at its disposal protecting fighters which can take off and get to work without delay. That part of the fleet which is based on Gibraltar would be in parlous case if it had to wait for long-range fighters from Egypt to come to its assistance. Many a time have enemy aircraft which were trying to shadow our fleet been shot down by Fulmars from the accompanying carrier, and to dispense with that form of help would be a heavy handicap.

Except in the narrows to the south of Sicily, the Axis bombers which attack our ships have to be protected by long-range shore-based fighters, and even if our own long-range fighters could get to the place in time, they, as a class, would have no advantage over the enemy's fighters. The single-engined fighters from a carrier can give, and often have given, invaluable protection to the fleet in such engagements. So it seems that, for the present at any rate, carriers are a necessity to the Mediterranean Fleet, even though the risk of loss is great.

As carriers go, H.M.S. *Eagle* was not a very valuable vessel. A ship of 22,600 tons which only accommodated twenty aircraft was an extravagant proposition. Even so, in the circumstances her loss is a blow, though the Navy is doubtless glad that it is only the *Eagle* which has been lost and not one of the new carriers of the *Illustrious* class. We may all be very thankful that the great majority of the *Eagle's* officers and men have been saved to fight another day.

Aircraft in the East

WHILE the terrible and critical battles rage in Russia, it is strange how little appears in the reports about the work of aircraft on either side. A German communiqué about the Russian offensive in the Rzhev area contains the statement: "All to-day bombing attacks by the *Luftwaffe* on Russian positions and tank concentrations brought much relief to the Army units," but this remark is exceptional. The bombers are evidently used on both sides as long-range artillery, playing their due part beside other arms in the mighty struggle, but evidently neither side is making any attempt to win the war by independent air action.

Looking farther eastward, the United Nations Command in Australia has for weeks past been carrying out

a defence by bombers, harrying the Japanese positions in Rabaul and New Guinea, and by that means checking the advance of the enemy until the American Forces were ready to undertake their invasion of the Solomons.

Of course, offence and defence are terms whose meanings often overlap, and we can even recall a case in which a simple-minded pacifist at a meeting of the League of Nations Union enquired how a fighter could be considered a weapon of defence, as it attacked bombers with its machine guns. The distinction between strategic defence and tactical offence was more than he could grasp.

Sir Charles Portal's Words

THE Chief of the Air Staff has written a striking article in the Chicago *Flying*, declaring that the time is not far off when the British and American bomber squadrons in this country will be able to destroy the industry and power of Germany at a rate which outstrips repair. He dealt also with the effect on the civil population of Germany, but added that our bombs are attacking the factories and workshops which are constructing tanks, lorries, aircraft and submarines, on which the enemy's striking power is founded.

The coming of large sections of the American Army Air Force to this country naturally makes a great difference to the power of the native air arm, which was getting somewhat stretched by the demands of the Battle of the Atlantic, the Middle East, the Far East, and Russia.

CONTENTS

The Outlook	191
War in the Air	193
Here and There	196
Engine Power	197
Behind the Lines	200
The B.M.W. 801A	201
Aircraft Characteristics	202 a and b
Fortress Squadron	203
Dornier Diving Brakes	205
In Parliament	206
Estimating Take-off Weight—II	207
North American Mustang	209
Correspondence	212
Service Aviation	213

It was very appropriate, just after the publication of this article by the Chief of the Air Staff, that General Spaatz, who commands the American Army Air Force in Britain, should have given an interview to the British Press, which was attended by Air Marshal Peck on behalf of the Air Staff. American fighter squadrons use Spitfires, because that gets them to grips with the enemy most quickly, but the Americans are sticking to the use of their own bombers, with which they are well satisfied. However, those bombers will take British bombs. More bombers are what this country needs, so the Americans bring their own, besides supplying others to R.A.F. squadrons.

IN BRITAIN NOW: Ground crews of the U.S. Army Air Forces working on a Boeing Fortress at one of the air stations taken over by the Americans. The tanker in the background is on loan from the Royal Air Force. A record of a visit to one of these stations appears on pages 202 and 204.

War in the Air

MALTESE FIGHTER : A British Beaufighter taking off from an airfield in Malta to protect a convoy on the way with supplies. These long-range fighters have considerably extended the island's air umbrella.

Heavy Bombing of Germany : Loss of H.M.S. "Eagle" : Axis Barges Off Libya : Americans at Navarino : Fewer Convoy Ships Sunk

OSNABRUCK in the Ruhr felt the weight of Bomber Command's heavy fist on the night of August 9th-10th, and over 450 tons of bombs were dropped on it, of which nearly 50 bombs weighed 4,000 lb. each, while 70 and 80 were one-ton bombs. It was what Bomber Command looks upon as quite an ordinary effort, and less than 200 of our air crews claimed to have attacked the target. Yet in the two heaviest attacks which the *Luftwaffe* made on London during the height of the *blitz*, namely those of April 16th and May 10th, 1941, the tonnage of bombs dropped on each occasion, so far as our experts could estimate it, was less than 450. In the notorious raid on Coventry the weight of bombs dropped was under 200 tons. It is clear that the most strenuous efforts of the *Luftwaffe* have been surpassed by Bomber Command, and it is also a point to mark that "four-figure" raids are not the only ones which are worth while. Moreover, weight of bombs dropped is not the only criterion of the effect of a raid. Sometimes fire-bombs do much more harm than the high explosives, as was the case at Lübeck.

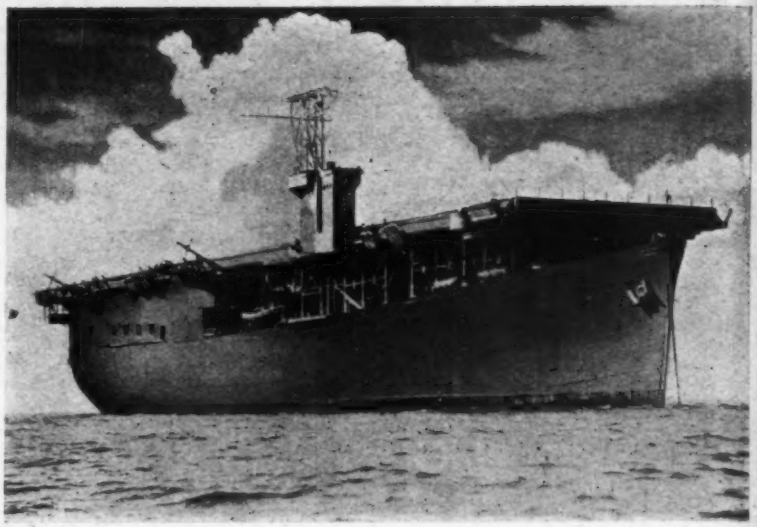
Summer months have short nights and do not invite long trips over hostile country, but on the other hand they seldom prevent operations altogether. In the period July 12th to August 11th of this year Bomber Command had machines over Germany on 13 nights, and on only one occasion was the number less than 100. Once it was over 600, and on ten occasions it was between 200 and 400 machines. There were also harassing attacks by daylight on 26 days (this is not reckoning the activities of Fighter Command and Coastal Command), and there were only three periods of 24 hours on which no operations were undertaken. The way in which the strength of Bomber Command has grown in the last three years is shown graphically by the following comparative figures. Taking the two-month period of June and July, being the latest for which statistics are available, in 1940 the Command dropped (in round figures) 3,500 tons; in 1941, 8,500 tons; and in 1942, 13,000 tons. What was the promise which Goring made to the citizens of Reich towns

CLOSE WORK : We have heard of Stirlings turning fighter and chasing Me 109's out of the sky. From this photograph it is apparent that they can do their stuff in formation equally well. We wonder whether the rear gunner of the middle machine realises that the pilot of a Stirling cannot see his wing tips !

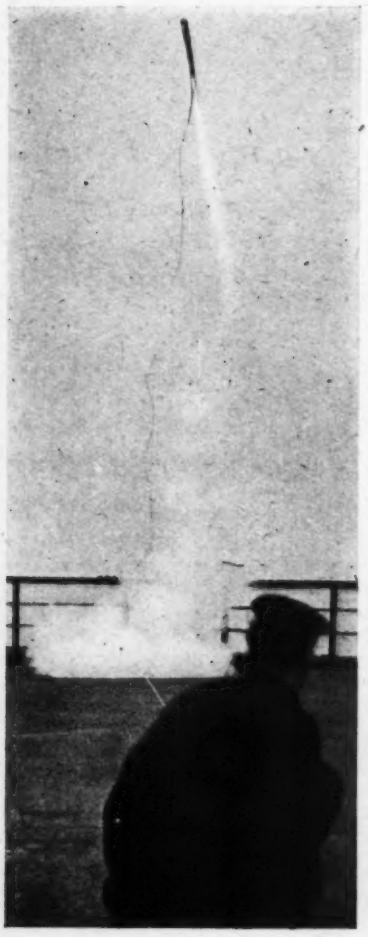
WAR IN THE AIR

before the war? No doubt many of them remember it, with curses not loud but deep.

The carrier H.M.S. *Eagle* has gone at last, victim of a submarine in the western Mediterranean. To some of us older followers of air matters she recalls the Schneider contest of 1927, when she lay off Venice, much for the same reasons that the U.S. warship *Pittsburgh* came to Cowes for the 1920 Schneider. But she spent a good portion of her service life on the China station, and if the British prisoners in Hong Kong hear the news they will have far more memories of the old carrier to recall, some, perhaps, of entertainments and jollities on board. Her history was certainly strange, for she was originally laid down in this country as a battleship for the Chilian Navy, to be called *Almirante Cochrane*, but she had not been finished by August, 1914, and so was taken over by the British Admiralty. She was not finished in time to take part in the last war. In 1924 she was converted into an aircraft carrier, presumably because she did not harmonise well with the other battleships of the Royal Navy. She was fairly large, 22,600 tons displacement, but only accommodated 20 aircraft. In the present year she was just about the least useful of our carriers. Still, we may remember that her Swordfish took part in the famous attack on Taranto, though the *Eagle* herself was not present, and her T.S.R.s flew off from H.M.S. *Illustrious*.



FOR THE AIR/SEA WAR : One of the merchantmen which the Americans have converted into aircraft carriers for convoy protection. Hangarage for about 30 aircraft is provided.



ANTI-DIVE BOMBER : The rocket device used by the four maritime regiments of the Royal Artillery. A rocket takes a wire high into the air and at the end of its travel a parachute opens to let the wire down slowly.

It may be assumed that the lull in the fighting in Egypt has been because both sides have wanted reinforcements. General Auchinleck has obviously been cautious, and one cannot forget the heavy tank losses suffered by the British in the battle of Knightsbridge. With his supply lines running all round the Cape it naturally takes time for him to bring his armour up to strength again. In the fighting which has been described he has been noticeably careful not to risk his remaining armour too much, doing as much as possible with infantry, artillery and air forces. It is fortunate that he seems still well supplied with the 25-pounder guns which have proved such a success.

The delay must be galling to both sides. Rommel must be tantalised at being so near the great prize of Alexandria without being able to grasp it. The British object has always been to attack until Rommel's forces are destroyed. But while the reason for marking time on the British side is obvious, one must speculate as to what is delaying the Axis. The enemy has lost huge quantities of motor transport from the air attacks of the British, and his lines of communication are long and difficult, though not so long as those round the Cape. It has been noticed that Rommel has been making much use of barges from the ports of Benghazi and Tobruk to bring stuff up to his forward positions, thus saving ground transport, and the Empire aircraft, very often naval T.S.R.s, have been concentrating their attentions on these and taking heavy toll of them. Our heavy bombers, including the American units, have made almost nightly raids on Tobruk, and often on Benghazi, and it is reasonable to suppose that they have destroyed large quantities of material which the Axis fighting troops sorely need. In these ways the air has been

WAR IN THE AIR

ENEMY AIR LOSSES TO AUGUST 15th

	Over G.B.	Over Continent	Middle East
Aug. 9	1	0	3
" 10	3	0	
" 11	1	0	17
" 12	1	0	
" 13	2	0	
" 14	1	0	
" 15	0	0	0
	9	0	20

Totals: West, 6,168; Middle East, over 4,423.

doing great service for the armies round El Alamein. It has been stated that one coastal barge can carry 100 tons of stores, and that to sink one is as useful as knocking out 20 lorries on land. The soldiers which have been sent over by air have not brought the German and Italian units up to full strength, and, judging by prisoners, they are largely of poor quality.

The beautiful bay of Navarino in the south of Greece was once the scene of a historic battle when a British fleet destroyed a Turkish one, and so led to the freedom of Greece. The other day it was the scene of another successful engagement which may help towards a second freeing of Greece.

BRITISH AIR LOSSES TO AUGUST 15th

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent F'trs.	Middle East A'crft.
Aug. 9	0	0	0	2
" 10	0	6	1	
" 11	0	0	1	
" 12	0	0	0	15
" 13	0	16	0	
" 14	0	5	0	
" 15	0	0	0	0
	0	27	2	17 (2 pilots safe)

Totals: West, 4,385; Middle East, about 1,571

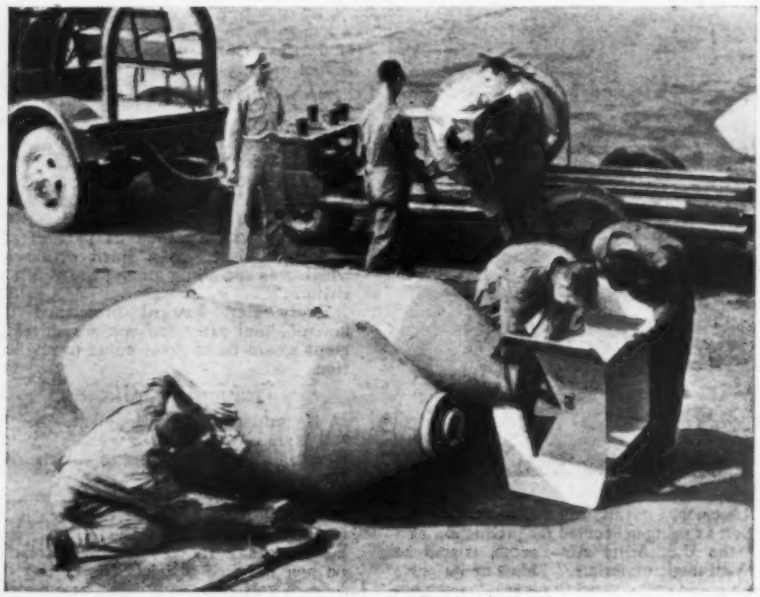
A VETERAN DIES GAME: H.M.S. *Eagle*, one of our oldest aircraft carriers, which has at last been sunk while convoying supplies to Malta. It was aircraft of the *Eagle* which helped those of H.M.S. *Illustrious* to do so much damage to the Italian fleet in the moonlight torpedo raid at Taranto.

American Raiders

AMERICAN heavy bombers made a dusk attack on the place, and found four enemy cruisers lying close together in the bay. One vessel received two direct hits, and two others were obviously damaged by misses which came very close. Explosions occurred on two and black smoke was seen pouring out of the third. American bombers in the Middle East have made a number of daylight raids recently, some of them on Tobruk. The bomb-aimers have revelled in the chance to see their targets so clearly.

One of the heaviest and most concentrated of Bomber Command's recent raids was the attack on Mainz during the night of August 11th-12th. This was carried out by a "strong force," and lasted for 46 minutes, during which time hundreds of tons of bombs, including more than 50,000 incendiaries, were dropped on this manufacturing city which is a railway centre and river port.

The attack was followed up by another raid on Mainz the next night, when our bomber crews found fires still burning, and the severity of this double attack may be gauged from the fact that the Germans themselves admitted "widespread destruction and extensive fires" in their subsequent broadcast.



SOON FOR DELIVERY: Armourers of the U.S. Army Air Forces preparing 4,000 lb. bombs for fitting to the bomb racks. They are a different shape from ours but the effect will be much the same.

Kenneth Gordon Seth-Smith who unfortunately lost his life in a flying accident on August 11. Before the war he was with the General Aircraft Company and shortly after the outbreak of hostilities he joined the Hawker Company's pool of test pilots. He was a pilot of outstanding skill and will be deeply missed by all who knew him.

HERE AND THERE

Fairey Test Pilot

MR. F. H. DIXON has been appointed chief test pilot of the Fairey Aviation Co., Ltd. One of the best-known test pilots in the country, Mr. Dixon, who was educated at Clifton and Cambridge, joined the R.A.F. in 1932, and from 1933 to 1936 was a member of No. 1 Fighter Squadron.

He was a pilot of one of the five Fairey Fury aircraft which gave demonstration flights in Canada in 1934, and he took part in the R.A.F. Hendon Pageants in 1935 and 1936.

Mr. Dixon was transferred to the R.A.F. Reserve in 1936, which year he joined Fairey's staff as a test pilot.

Back in Harness

WE are informed by Vickers, Limited, that Sir Charles Craven, who has now recovered from his recent illness, has resumed his duties as Chairman and Managing Director of Vickers-Armstrongs, Limited, and English Steel Corporation, Limited.

Parliamentary Pedallers

WHEN the Prime Minister piloted a flying boat for a few minutes it made front page news, but one can imagine the feverish excitement which would have stirred Fleet Street had the Home Secretary accepted an invitation recently extended to him in the House by Commander King-Hall.

The Honourable and Gallant Member had raised the question of allowing cyclists more light in the coming winter months, and when Mr. Morrison intimated that the matter had been under consideration, the Commander said:—

"If the right honourable gentleman is in any doubt as to the urgent nature of this, will he accompany me on a tandem on a tour of London and see for himself the troubles and difficulties that bicyclists are in?"

A snap of the Home Secretary making "several steeply banked turns" round Piccadilly with the gallant Commander in the "second pilot's" seat of a tandem would have been a marvellous scoop!

Air Ministry Changes

THE following appointments, to date from Monday last, have been announced by the Air Ministry.

Air Marshal Sir William L. Welsh, for special duties.

Air Marshal Philip Babington, to be Air Officer Commanding-in-Chief Flying Training Command, *vice* Sir William Welsh.

Air Marshal Sir Bertine Sutton, to be Air Member for Personnel, *vice* Air Marshal Babington.

Rhodesia Airwomen Knit for W.A.A.F.

MEMBERS of the Women's Auxiliary Air Service in Southern Rhodesia are knitting comforts for their sister Service, the Women's Auxiliary Air Force, in this country.

They are making woollen pullovers for the W.A.A.F. cooks, who often have to be on duty in R.A.F. cookhouses and messes all night to prepare meals for the flying crews coming back from operations, and they knit scarves, gloves, mittens, and jerseys for the W.A.A.F. girls who "man" barrage balloon sites, for M.T. drivers, and the many other airwomen whose duty necessitates their being out of doors in all weathers, winter and summer.

These Rhodesian W.A.A.F. are also making voluntary contributions towards a fund with which other comforts will be purchased. Theirs is an independent organisation administered by the Southern Rhodesian Government, and its members are serving at R.A.F. stations of the Empire Air Training School there.

F. H. Dixon, who has recently been appointed chief test pilot to the Fairey Av. Co., Ltd.

KENTUCKY MONSTER: A new Curtiss transport aircraft, the C-76, was recently announced by the Curtiss-Wright Corporation as being scheduled for production at a new factory in Kentucky. Intended for the U.S. Army Air Forces, it will be constructed mainly of wood and "other non-strategic materials." Most of its parts are to be built in small assemblies by firms already experienced in plywood construction. No official details of the aircraft are yet available beyond the fact that it will be of the two-engined type (presumably Wright Cyclones), but this *Flight* drawing has been prepared from a U.S. War Department sketch and shows the general appearance of the forthcoming Curtiss C-76.

A.T.C. Progress

ALTHOUGH the Air Training Corps is now more than 250,000 strong and comprises 1,619 units, including 356 school and 23 university squadrons, Air Chief Marshal Sir Robert Brooke-Popham, who inspected the 173rd Squadron at Orpington, Kent, last week-end, said that we were really only at the start of air development, and the end was nowhere in sight.

There was, he said, a corporate spirit in the A.T.C. inspired by the fact that the corps was regarded as part of the R.A.F., and it was a spirit of service which was spreading among the youth of Britain.

Every step forward broadened the horizon, and after the war air development would be of great value to civilisation.

Training in Gliding

AN important development in the training of A.T.C. cadets is the recent addition of gliding to their activities.

This has brought with it the problem of suitable sites, and Air Comdre. J. A. Chamier, Inspector of the A.T.C., said last Saturday that this would probably be met in some districts by seeking the help of golf clubs and racecourse people, who would be asked to allow local squadrons to use some of their land. Only elementary instruction is being given at present.

ENGINE POWER

Development in Production : Parent Firms' Development Departments : Shadow Factories : Liaison Between Engine and Aircraft Designers

By Group Capt. F. R. BANKS, O.B.E. (Mil.)

THE Directorate General of Engine Production in the Ministry of Aircraft Production is responsible for ensuring that adequate capacity is available for the manufacture of engines to meet airframe requirements. In planning this capacity with the various aircraft engine manufacturers, due account has also been taken of the need for spares—in terms of complete engines and also "bits and pieces." This may mean, in the case of an entirely new engine, completely new jigging and tooling, together with the provision of additional and, perhaps, special-purpose plant, or, if the engine to be produced is another version, or "mark," of an existing type, only particular jigging and tooling for the altered or new parts.

However, before all this happens, a great deal of development work on the new model will have been done by the firm concerned, in order to see whether, in the first place, the engine will give the improved performance expected of it and to force the pace if it doesn't, and, finally, when this improvement is obtained—be it higher take-off power and greater power at altitude or better specific fuel consumption—whether the new engine is reliable. It cannot be said too often that, in the particular case of the aircraft engine, "development *is* production." It is only by intensive development that a successful engine can be put into full production uninterrupted (relatively) by modifications. Of course, many modifications have to be faced, but major modifications, which are due to lack of, or ineffective, development have a disastrous effect upon production.

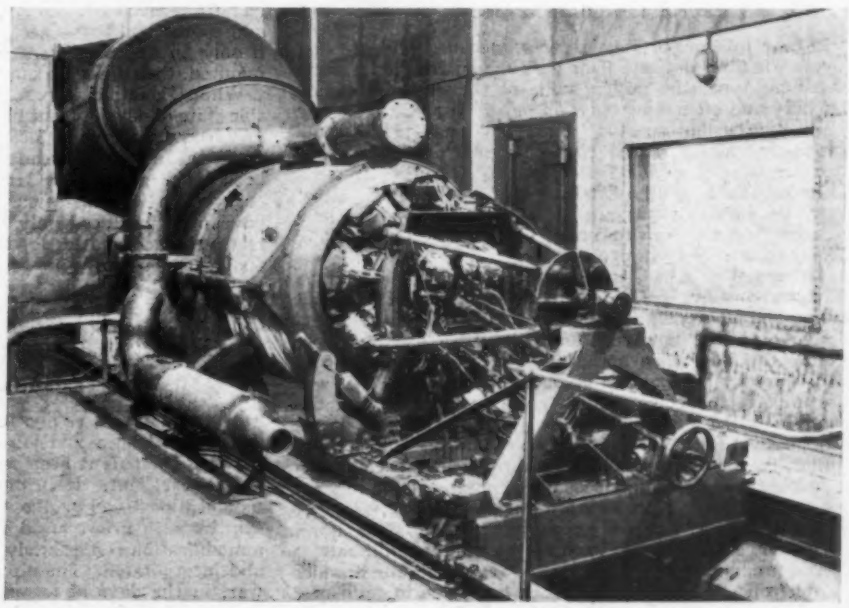
This article by Group Capt. Banks, who is Deputy Director General of Engine Production, Ministry of Aircraft Production, was originally written for American readers. It shows the many facets of the problem of producing complicated engine structures during the stress of war.

It pays the parent engine firm to have a large development department with plenty of machine tools and adequate test equipment, and a capable staff with someone with foresight at the helm who is in direct contact with those who use his firm's products. In addition, there must be a large staff of capable installation engineers whose job it is to go out into the field and supervise the handling of the new engine.

The production organisation of the large aircraft engine forces has often been criticised; it is said that they could produce many more units with a better shop layout. Their critics are usually ignorant of the evolution of the average high-duty aircraft engine, and cannot see that, in the past and prior to the war, most of these firms were just one big development department with few special tools and many general purpose ones. And that they were, and are still, the places in which engines are born. Their job is to nurse those engines through their teething and growing-pain periods.

The demands of war are such that it is often necessary to introduce quickly and of necessity, in limited numbers, an engine of improved performance to fit an existing type of aircraft. It is then that the value of the firm having a large and efficient development section is appreciated. And how many times during this war have we been thankful for such a firm. Since the close of the last world war there has been a small but robust group of companies in Great Britain designing and manufacturing high-quality aircraft engines. And even in the lean years that the British aircraft industry has faced on different occasions since 1918, the air staff was able to keep the chief aircraft-engine firms alive. Both this policy and this fact have been of inestimable value to British aircraft designers, who were thus assured of the advantage and co-operation of an efficient and progressive sister industry. British aircraft engines have kept abreast of world design, and they have undoubtedly influenced foreign design considerably as well as being licensed for production in most foreign countries. The number of designing and production forces can be counted on the fingers of one hand; they are generally known as the parent firms. The three principal forces are Bristol, Rolls-Royce and Napier.

In order to meet war requirements the parent aircraft engine firms have been expanded, and other factories have been built to manufacture their engines on a production basis. The latter, naturally, are not concerned with development—only production. They are, in some cases, managed by the parent firm, and in others are staffed,



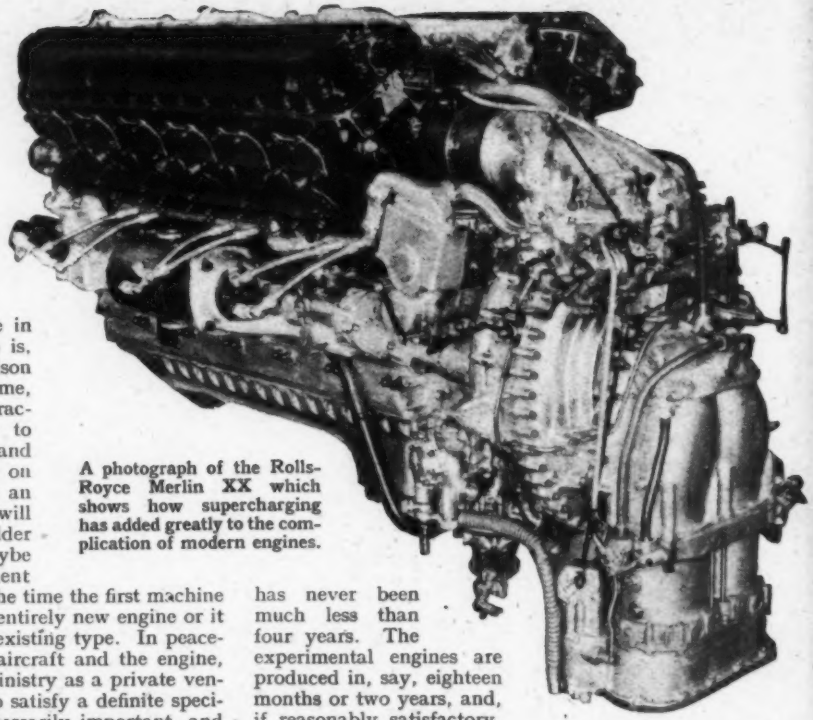
A Bristol Hercules sleeve-valved engine on one of the ultra-modern test beds which the Bristol company use in their engine plant.

D

ENGINE POWER

managed and run by a number of famous British automobile manufacturing concerns. These plants, in most cases, are known as "shadow factories," but they are in fact, large Government-owned factories managed and run for the M.A.P. by industry.

The history of British aircraft engine production in this war will be written some day, and it will have a deservedly high place in the annals of engineering. There is, in the first place, a very close liaison between these firms and the airframe, or aircraft, builders. The normal practice is for an aircraft designer to visualise forward requirements and put a design for a new aircraft on paper which in turn will call for an engine of a certain power. He will approach the aircraft engine builder and ask what he has to offer. Maybe he has nothing to offer at the moment but will have something ready by the time the first machine is on the stocks. This may be an entirely new engine or it may be an improved model of an existing type. In peacetime, such a combination, of the aircraft and the engine, might be put forward to the Air Ministry as a private venture, or it might have been built to satisfy a definite specification. Time, then, was not necessarily important, and the prototype machine would be built in due course and tested. If it was promising, a few more would be built for use in R.A.F. squadrons so that experience could be gained before a production order was given. From the time the project was first considered, to the time when the machine was in full production, might be anything up to four or five years. And, as is usually the case with engines and aircraft, it would probably be obsolescent; new marks of the same engine would already be appearing at least experimentally to replace it.



A photograph of the Rolls-Royce Merlin XX which shows how supercharging has added greatly to the complication of modern engines.

Modifications and Tooling

In war, of course, time is very precious, and as soon as the Air Staff indicate their wish for an aircraft of some particular type, the design staffs of the firms concerned get busy and offer something, *on paper*, in a relatively few months. The "prospectus" for a new machine will come out fairly quickly, based on the aggregate knowledge of the aircraft and engine builders, but, of course, it takes many months to do the detailing of a new aircraft. However, the needs of war are such that an aircraft is now ordered "off the drawing board" and jigging and tooling begins soon after its design is approved.

The speed at which this machine, as a whole, will be produced and flying depends upon the success of its initial design and also upon whether the engine is of entirely new design or is an improved "mark" of an existing type. Before the war when speeds ranged around 200 m.p.h. and when the biplane was favoured by the R.A.F., it was not difficult to evolve a new type of machine. But the change to the monoplane, and the demand for speeds around 300 m.p.h., brought a whole train of trouble, wing flutter, for example, which had not previously been apparent. Now we speak quite casually of speeds of 400 m.p.h.; and the difficulties of the aircraft designer are further increased. Two years will probably elapse from the initial design stage to the completion of the prototype aircraft.

The production of the engine, however, is quite another matter, since it takes about four or five years to get a new type engine into production, from the drawing board. This period will vary according to the ability of the development department or the engine firm in question, but it has never been much less than four years. The experimental engines are produced in, say, eighteen months or two years, and, if reasonably satisfactory, are given a special category test in order to enable them to be put into the prototype aircraft so that flight testing can proceed. In the meantime, the development of the engine on the test bed is being pushed hard and the jigging and tooling for its production is going ahead. It is, of course, known what machine tools will be required, in numbers and type; but, inevitably, the jigging and tooling may have to be altered according to the degree of trouble met during bench and flight testing and the consequent amount of redesign which becomes necessary. So, eventually, a complete aircraft is evolved during wartime. But a good deal of frantic work, both on the part of the aircraft and engine builder, is necessary to produce it. Naturally, if only an improved version of an existing engine type is required, then a certain amount of time is saved.

While, therefore, in peacetime an engine was in a reasonable state of development before its production commenced, in wartime we have to face a good deal of teething trouble while the engine is already being flown, and, in fact, has been fitted in relatively large numbers in aircraft actually engaged on war operations. Where, in the past, engines have been produced only by the parent firms, it was a relatively easy matter for the parent company to produce and keep step during production with any alterations which may have become necessary as the result of further development. But now engines have to be produced by firms which have not previously had aircraft-engine experience, such as the "shadows."

Shadow Industry

The "shadow" engine industry in this country has undoubtedly done a fine job of work, and the co-operation between the parent firms and their "shadows" has been, and is, excellent. It is, of course, difficult to introduce a modification to an engine when it is in large-scale production by such firms. And every care is taken to see that a modification is absolutely necessary before it is approved and incorporated. The aircraft engine industry before the war, in the days of retrenchment, was not large enough to support the demands with which it is now faced for skilled workmen. Indeed, there is a general shortage throughout the United Kingdom of skilled machinists and

fitters, consequently large training schemes have been initiated. Men and women from all walks of life are now in our factories operating machines and assisting in the assembling and testing of aircraft engines—insurance agents, shop assistants, milliners, manicurists, clerks, actors, actresses, musicians, and so on. These men and women have shown remarkable keenness in their new work, and many have demonstrated real ability. One of our "headaches," particularly acute in 1940 and 1941, has been the difficulty in finding managerial staff.

In the heavy bombing period, after the fall of France and during the Battle of Britain, it was necessary to disperse some of the larger factories. It is not generally realised how difficult this was, because it meant multiplying supervisory staff and often housing workmen in rural areas hardly capable of accommodating more than a few thousand of their own inhabitants. Yet it has been done with only a temporary drop in production which overall has continued steadily to increase.

There are many "marks," or varieties, of aircraft engines in production in Britain to-day. Indeed, one of the problems of the Directorate General of Engine Production is the rapid improvement in engine types. There may be six new types in production now; there will be as many further improved types to produce twelve months hence. If an engine is outstandingly successful, the Air Staff will wish to get as many into operation as quickly as possible. A hundred fighters, modified to take a new engine, may be demanded for delivery within a matter of a few months. This raises at once a multitude of difficulties. The airframes themselves have to be modified. The installation and equipment may have to be changed. The capacity required for, say, new radiators must be doubled, and so on. The question of spares also arises. Aircraft, whether in the front line or in reserve and according to type, need, in addition to their basic quota of from one to four engines, a certain number of spare engines. All these spare engines require spare parts, which must be despatched and held in store for maintenance wherever the engine is to be used. The demand for spare parts is enormous, and absorbs a large part of the productive capacity required for the manufacture of the complete engine. This, coupled with the "production cycle," that is, the time taken to obtain materials, plan production, fabricate and assemble the component parts of an aircraft engine, stretches the resources of the engine industry severely.

Emergencies arise and must be dealt with swiftly. Last year, during the "blitzing" of Britain, the necessity for flame damping the exhausts became apparent. This entailed a new design of exhaust system which, when finalised, had to be fitted with all possible speed. Working parties had to toil night and day to fit these systems so that the night fighters could get within firing range of the bombers undetected.

Finally, a word about the actual engines. The two most famous British makers of engines whose products had a world-wide reputation even before the war, have more than justified this reputation—Rolls-Royce and Bristol. Their engines have made history. The Rolls-Royce "Merlin" is a liquid-cooled, 12-cylinder V engine, which started its life by giving 900 h.p. at what is now regarded as a very low altitude. To-day it has a 50 per cent. better all-round performance, and has been developed to maintain it at extremely high altitudes.

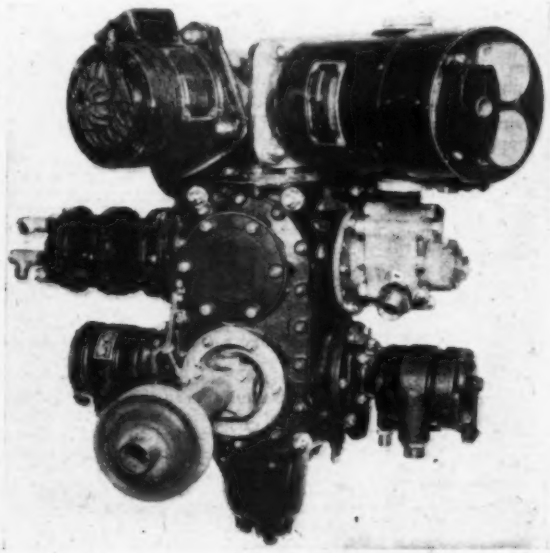
The Bristol Company, famous for their air-cooled Pegasus and Mercury poppet-valve engines, which are still giving valuable service in a number of important operational aircraft, started producing their new 14-cylinder sleeve-valve air-cooled engine, the Hercules, before the war. It is now in full production, and gives more than 1,500 h.p.

The Napier Company have also developed, and are building, a liquid-cooled sleeve-valve 24-cylinder H engine, known as the "Sabre." This engine has yet to win its spurs in war, but it can be stated that it is the most compact engine yet built in any country for a power of over 2,000 h.p.

Rotol Gear Box

DURING the early days of the war, when the call went out for development as well as production, Rotol Airscrews, Ltd., interested themselves in power unit problems and created a division for the development of engine auxiliaries under the direction of Mr. D. R. Pobjoy, the aero engine designer.

The first auxiliary for development was a driving unit, or gear box, for ancillary equipment which would not only relieve the engine of a number of projections, but also facilitate maintenance and installation.



Typical installation of auxiliary equipment on a Rotol universal gear box.

A unit of this type, known now as the "Rotol Universal Gear Box," has been well tried in production. It has been produced, as its name implies, to suit practically every type of aircraft. It is driven from the engine by a shaft and flexible coupling, and may be mounted either in front of or behind the fireproof bulkhead. The gear box is of rectangular shape and has on either side two horizontal transverse drives, one mounted vertically above the other, and each provided with standard flanges for the fitting of various types of pumps. It may carry as many as seven pumps of various kinds and two electric generators, in addition to standardising the fitting of all ancillary equipment.

A Trip in the Lancaster

FLIGHT has been given the opportunity of a trip aboard the Lancaster with Capt. H. A. Brown at the controls. From the end of the 1,200yd. runway, and with a deep roar from the four Merlin engines, developing some 5,000 h.p., the huge thirty-ton machine rapidly gathered speed; in a few seconds was tail up and in three or four hundred yards airborne and climbing lustily. The manœuvrability is remarkable and the demonstration, which included diving on to a target, followed by quick climbing, revealed the ease of handling, the responsiveness of controls, and the possibility of tight turns which would be useful in evasive action. A speed of 280 m.p.h. was attained on one occasion. Visibility is first rate and the roomy interior provides adequate comfort for the crew. Approaching the landing ground at 120 m.p.h., the landing speed was under 100 m.p.h. Truly the Avro Lancaster is a worthy addition to Britain's unexampled fleet of four-engined heavy bombers which are now wreaking such devastation in enemy countries.

C.W.A.C. Sight Testers

THIRTEEN corps members of the Canadian Women's Army Corps have completed a technical course at Ontario which will enable them to test the night visual rating of drivers, parachute and aircraft spotters.

BEHIND THE LINES

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

From Hungary

AN institute for aerodynamic research has been established at the Technical College of Budapest. The Hungarian Air Ministry, which has provided the necessary funds, is reported to have equipped the institute with all modern appliances, including a wind tunnel with a diameter of 9ft. 8in., and a velocity of flow of 262 ft./sec.

Vichy Airlines

ACUTE shortage of aviation fuel has forced the Vichy authorities to restrict their air services. The Toulouse-Marseilles-Lyons-Vichy, and the Toulouse-Vichy services have been suspended. The schedule of the daily service Marseilles-Algiers-Tunis is also likely to be reduced. The "Courier Service," operated with Amiot 370 twin-engined aircraft between Unoccupied France and Jibuti, has also been suspended. Thus the only remaining route in operation is the daily air mail service from Toulouse to Marseilles.

For Members of Regia

MEMBERS of the *Regia* have now formed an association with headquarters at the offices of the Royal Italian Aero Club. The object of the association is to ensure a close collaboration with the Fascist Party and to promote civil flying. Both active and retired members of the *Regia* are eligible, but must give an oath of allegiance to the Duce and the "Fascist Revolution."

Those who are not full-fledged members of the Fascist Party, however, are not allowed to wear the party uniform, and have to be satisfied with wearing, at meetings, a regulation dark mufti with a badge on their coat lapel.

A German Report

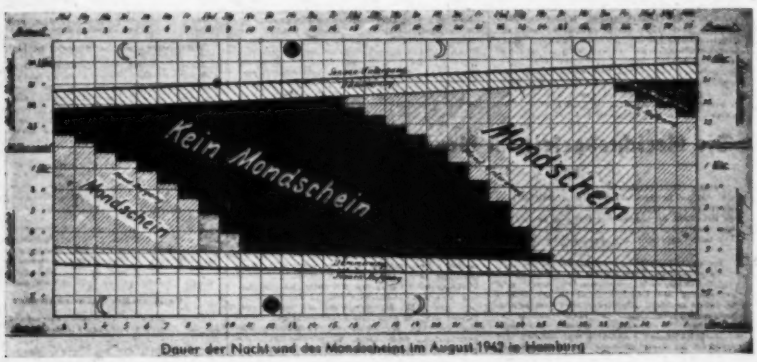
IN a widely circulated article signed by General Quade, an official spokesman of the German Air Ministry, some interesting details are given about *Luftwaffe's* share in the recent fighting on the Russian front. It is stated that prior to the German offensive in the South the *Luftwaffe* has been entrusted with the task of a thorough reconnaissance of Russian positions and fortifications. This comprehensive photographic reconnaissance work was of utmost importance for the preparation of plans for the attack on the strongly fortified Russian positions. With the beginning of the offensive the main weight of *Luftwaffe's* operations was transferred to the constant support of the ground forces by bombing Russian forts and artillery positions. At the same time the *Luftwaffe* had to wrestle with the Russian Air Force, which has put up a strong resistance. In this connection Nazi lapse of memory is striking: it is already forgotten that the same official spokesman published in September last year a long requiem for the "dying Soviet Air Force," and it is now claimed that 2,000 Russian aircraft have been destroyed between June 23 and the end of July. There is also a remarkable discrepancy between the German and Italian reports on the success of air fighting. While General Quade, who appears to have a liking for high figures, states that 127 Russian aircraft have been destroyed in one day in the fighting in the Veronezh area, the Italian report puts the figure at 15; but what does the difference of a mere hundred matter among friends!

The German report emphasises particularly the *Luftwaffe's* contribution to the operations of the ground forces in the Don and Caucasus area. In these operations—the report states—"*Luftwaffe* bomber and Stuka units have effectively hampered the orderly withdrawal of Russian troops by destroying bridges and preventing the Russians from concentrating reserves and artillery and from bringing up supplies." Stuka formations have been constantly engaged in attacks on motor roads, and are reported to have taken particularly heavy toll of Russian forces crossing the river. Incidentally, an Italian source reports that the Stuka Squadrons were escorted by Italian fighter formations equipped with the Macchi C202. The Italians do not underestimate the quality of Russian pilots or equipment. The Italian Official Agency reports on July 30 of violent combats in the Don Sector between escorting Macchi formations and superior numbers of Russian fighter units equipped with the "most modern monoplanes of the type "Mig and Yak."

ITALIAN HEAVYWEIGHT: The Piaggio P 108B bomber is powered with four Piaggio PXII RC 35 engines of 1,000 h.p. each. It has a span of 108ft. 3in. and a length of 81ft. 6in. Maximum speed is about 290 m.p.h. at 13,100ft.

Promotion and Losses

AT the beginning of this month six new Lieutenant Generals have been appointed in the *Luftwaffe*. The Officers promoted to this rank are Major Generals Korte, Osterkamp, Knauss, Franssen, Schwabedissen and Burchard. Lt. Hinrichs, of a Stuka Squadron, has been awarded the Knight's Insignia to the Iron Cross for the "destruction of A.A. positions in the Sevastopol area." Lt. Schoenert, a Commander of a night fighter squadron, receives the same decoration for the 20 aircraft shot down by him. Another bearer of the Knight's Insignia to the Iron Cross, Lt. A. Schmalz, of a Stuka Squadron, who took part in the *Luftwaffe* operations in Greece and Crete, has been shot down by Russian fighters in the Donetz sector. At present the two leading Aces of the *Luftwaffe* are reported to be Lt. Bauer, of a fighter squadron, who is credited with 102 victories, and First-Lieutenant Erwin Clausen, an ex-sailor, who has risen from the ranks and has taken part in all previous *Luftwaffe* campaigns. He is the 106th member of the German Armed Forces to have been awarded recently the Oak Leaves with the Knight's Insignia of the Iron Cross.



A TONIC FOR NAZI NERVES: This chart of dark and moonlight nights in August appeared in the "Hamburger Fremdenblatt" to calm down the inhabitants by showing when they are unlikely to be visited by the R.A.F.

THE B.M.W. 801A

Some Notes on the Lubrication System and Fuel Injection Equipment

By F. C. SHEFFIELD

IN our issue of Aug. 13th we published a description and comments on the B.M.W. 801 twin-row radial engine, as fitted in the Dornier 217 bomber and the Focke-Wulf 190 fighter. These notes on lubrication and fuel injection supplement the general report. Particular interest attaches to the new Deckel equipment by which fuel is injected directly into the engine cylinders by open type nozzles.

AS might be expected, the lubrication and fuel injection systems of the B.M.W. 801 engine present interesting features. In neither is any evidence to be found of a need or even an attempt to economise in material, skilled labour or machine tools. Judging from appearances, the aim was to produce the best job, with complete disregard of costs or the man-hours expended in production.

Lubrication System

In the high-pressure lubrication system no fewer than six gear-type pumps are employed. Referring to the schematic layout, oil from the tank is led to the inlet side of the two pressure pumps A and B. Pump A passes oil at a pressure of approximately 180lb. sq. in. through the two coolers arranged in series in the nose of the cowling. A spring-loaded pressure relief valve is provided in a line connecting the delivery to the inlet side of the pump to protect the coolers from excessive pressure. From the coolers the oil is returned to the common inlet side of pumps A and B.

Pump B forces oil through a German version of the Autoklean filter. The cleaning member of the filter is rotated positively from the pump spindle through a worm gear and a double reduction spur gear train at a ratio of 1 : 1,040. Bridging the common inlet to the pressure pumps and the filter is a capsule-controlled, temperature-sensitive relief valve which, when the system is warmed, maintains the main supply to the engine at a normal pressure of 110lb. sq. in. When the system is cold the loading on the relief valve is automatically increased and the delivery pressure to the engine is raised.

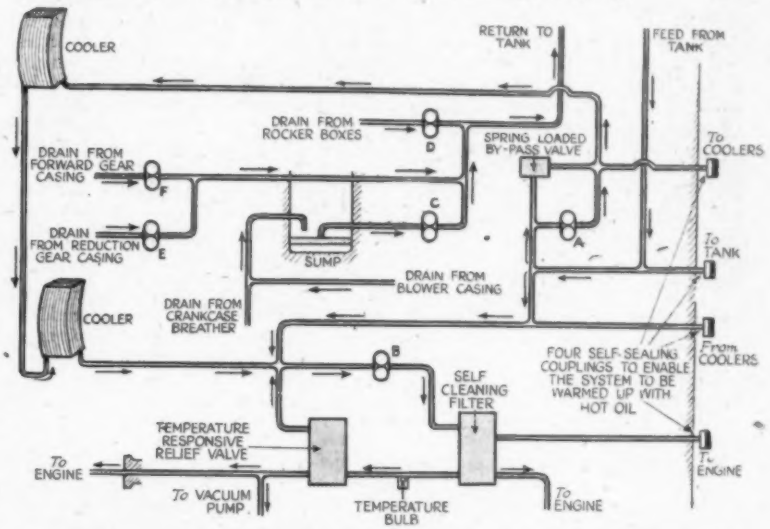
Four Scavenge Pumps

Drains from the blower casing and also from the oil separator unit deliver to the engine sump which is scavenged by pump C. Mounted vertically on the port side of the tubular mounting structure, the separator comprises a cylindrical casing into which oily vapour from the crankcase and also the oil tank is discharged by an axial tube. The air escapes to atmosphere through a stack of perforated sheet-metal discs which trap any entrained oil. Valve rocker boxes are drained by pump D, whilst the airscrew reduction gear casing and the forward gear casing are scavenged by pumps E and F respectively. All four scavenging pumps deliver by a common return pipe to the tank.

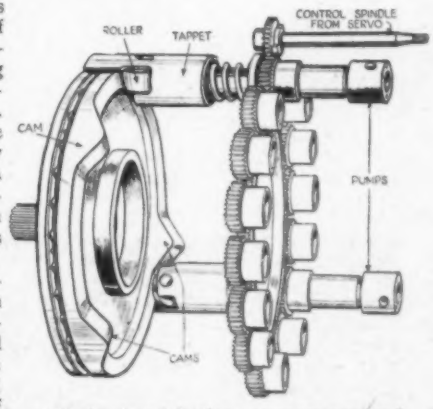
Direct Fuel Injection

The fuel injection equipment is of a new type, differing considerably from that employed on the earlier B.M.W. 132 engine. It is built by the Munich firm of Frederich Deckel, which, in times of peace, was best known for the manufacture of the Compur shutter used on high-class cameras. The pump unit is of cylindrical shape; the fourteen individual pumping elements lying parallel to, and arranged concentrically around, the longitudinal axis. Flange-mounted on the rear of the engine, the pumps are actuated by a three-nosed cam driven through a train of spur gears from the crankshaft at one-sixth engine speed. In the space enclosed by the pumps is housed a fuel de-aerator.

The fuel is supplied to a chamber in the rear end cover, from which tangentially-arranged passages lead to an axially mounted tube projecting into the common fuel gallery for the pumps. Fuel is swirled rapidly round the bore of the tube and passes into the gallery by way of a series of holes in the periphery near the closed forward end of the tube. Air and some fuel escapes by a small diameter axial nozzle in the rear end of the tube. The discharge from this nozzle is controlled by a ported piston valve. When the engine is at rest the valve is closed by a spring and thus the pump is maintained full of fuel ready for a start. The end of the piston valve is exposed to the fuel entry chamber, and, under supply pressure, the valve is automatically opened against the constraint of the spring.



Schematic arrangement of high-pressure lubrication system. Two pressure pumps, A and B, and four scavenge pumps, C, D, E and F, are employed.



The fourteen injection pumps are arranged concentrically around the drive axis and actuated by a three-nosed face cam running at one-sixth crankshaft speed Control sleeve pinions are interconnected by a floating circular rack.

THE B.M.W. 801A

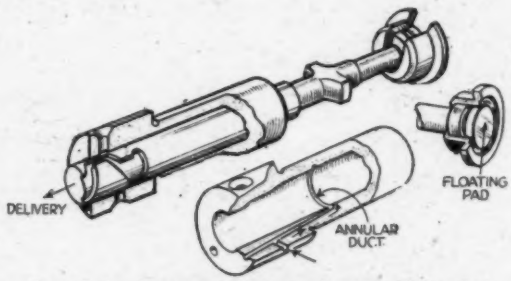
Pump barrels are an easy push fit in the housing and are frictionally secured about midway of their length by a channel-section spring ring. Radial adjustment of the barrel to align the ports for the datum setting is by a two-pin spanner engaging holes in the top face. A spring-loaded non-return delivery valve drawn down by a sleeve-type nut against the top face finally secures the barrel in its adjusted position. From the common gallery, fuel is led to an annular space around the head of the barrel whence it reaches the interior by a drilled intake port. Diametrically opposite, but at a slightly different level, is the spill port. Injection is terminated on the delivery stroke when the uncovering of this port by the plunger scroll relieves the pressure in the pump chamber and allows the fuel to escape back to the annular space. As shown in the sectioned perspective sketch, drillings in the wall of the barrel allow fuel from the annular space to reach a groove in the bore of the barrel to ensure lubrication.

As a further precaution against air in the fuel lines, the annular spaces around the two uppermost pump barrels, numbers 1 and 14, are connected by small diameter drilled passages to the outlet from the de-aerator in order to bleed fuel and any entrained air continuously from the fuel gallery.

Pump Control

The pump plunger has a dual scroll to control the duration of injection. It will be seen that any variation of the quantity of fuel delivered affects both the commencement and the termination of the injection period, but leaves the timing of the point of maximum delivery substantially constant. When, for example, the delivery is increased, injection commences earlier and finishes later. Control of this function is effected in the usual manner with a slotted sleeve floating on the pump barrel and engaging the cross head on the stem of the plunger. For simultaneous operation of the control, each sleeve is formed with a pinion and interconnected by a circular rack which floats in a recess in the main body of the unit and is retained by the overlapping edges of the plunger spring seating washers. These seating washers also determine the longitudinal clearance of the sleeves against a washer placed over the channel-section spring ring positioning the pump barrels. Backlash is taken up by a torsion spring mounted on the outer diameter of each sleeve, with one end anchored in the body and the other in the pinion.

The control spindle, servo-operated from the automatic control unit, carries a pinion in engagement with the sleeve pinion of No. 4 cylinder. The width of this control pinion is reduced over a sector of its diameter to accommodate a pin mounted in the body. This pin defines the permissible rotative movement of the pinion, and in turn of the control sleeves of all the pumps, and also prevents the torsional loading springs unwinding when the unit is detached from the engine and the control mechanism is uncoupled.



One of the fourteen individual elements of the fuel injection pump unit. The plunger has a dual "scroll" and is furnished with a self-aligning pad at foot abutting the tappet.

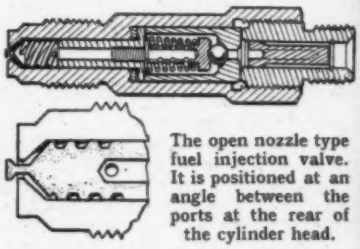
Actuation Gear

The circular foot of the plunger carries a floating cup-shaped member which centres and retains the plunger spring. This cup also serves as a carrier for the hardened steel self-aligning pad which is interposed between the end of the plunger and the head of the tappet. Tappets are furnished with a profiled roller running on a flanged bronze bush mounted on a steel pin. Pin, bush and roller are all assembled with running clearances. The flange of the bronze bush, serving as a thrust member between the face of the roller and the side of the tappet, is provided with radial oil grooves on each side. Registered and riveted to the flange of the splined drive shaft, the face-type actuation cam takes its bearing on a bronze bush pressed on the reduced end of the tappet housing half of the body. The forward face of the cam provides one track for a full diameter ball-thrust race. The other track is, of course, registered on the mounting flange of the unit, which completes the body structure and carries an oil seal for the drive shaft.

To avoid rotation of the tappet and consequent misalignment of the rollers in relation to the cam, each tappet is provided with a segmental extension, the ground edges of which loosely engage a split ring positioned concentrically around the cam and supported in the body casting. By way of drillings in the mounting flange and the body casting, oil from the engine lubrication system is delivered to the tappet enclosure for lubricating the actuating gear.

Injection Valve

Also of new type is the open nozzle fuel injection valve, which is shown in section. The spray orifice in the end of the body is a parallel boring, and through this extends the reversed conical head of the stationary needle. Closely fitting the bore of the body, the needle is positioned by a flange against a shoulder, and an interposed washer is employed to adjust the critical height of the head relative to the sharp-edged spray orifice and determine the characteristics of the spray cone. Incidentally, the diameter of the conical head is 2.01 mm. From the axial boring of the needle three drillings lead to the base of the three-start thread on the end which promotes a whirling motion to the injected fuel.



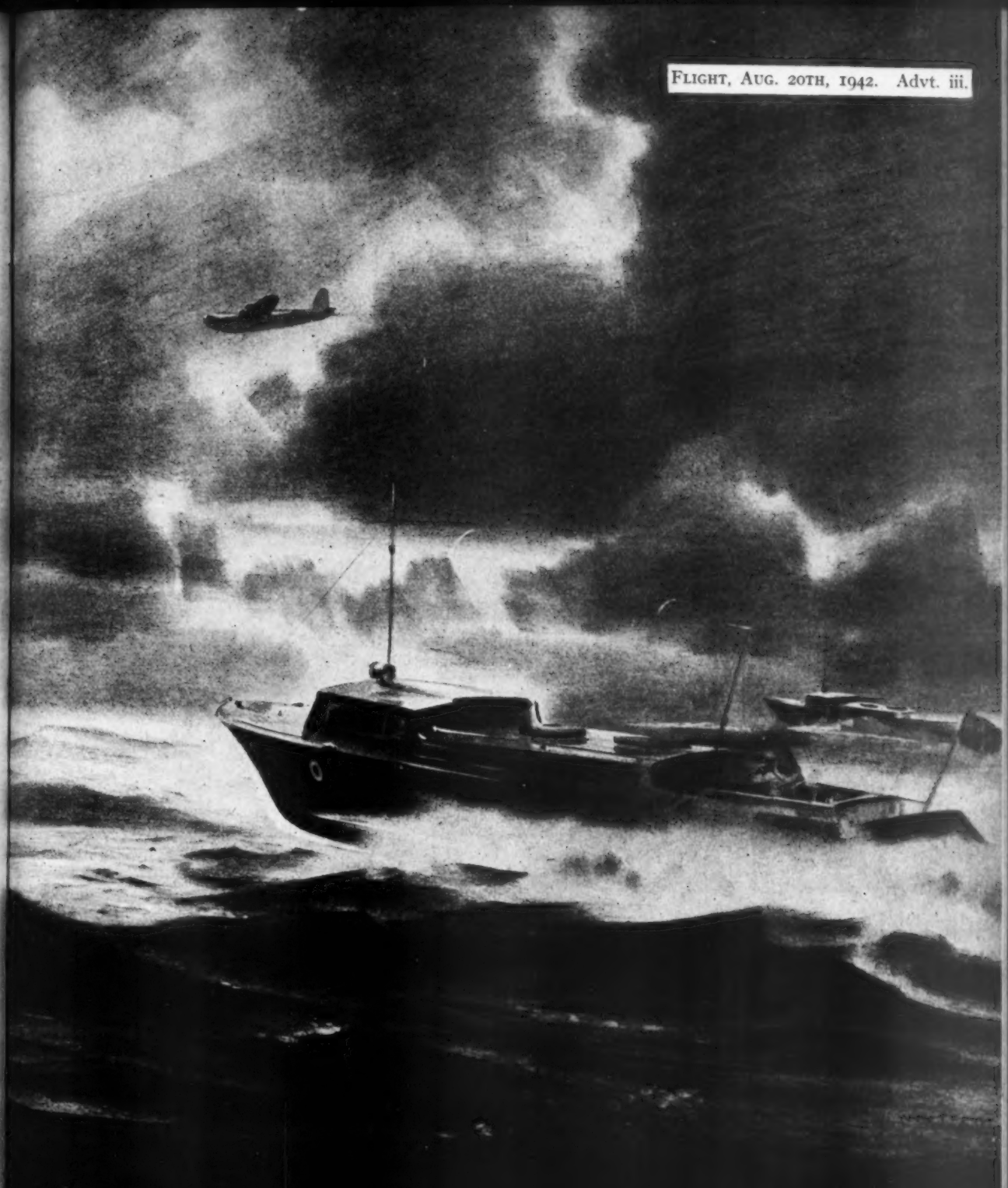
The open nozzle type fuel injection valve. It is positioned at an angle between the ports at the rear of the cylinder head.

At the flange end the boring is screw-threaded for an extractor tool.

The needle is held in position by the thimble-type housing of the ball non-return valve, which is in turn secured by a screwed adaptor. In the adaptor is housed a small fuel filter. The plug forming the central element is screw-threaded 0.1 mm. deep and is a drive fit in the parallel bore of the adaptor. Two diametrically-opposite longitudinal slots from the upper end are alternated with a pair of similar slots from the lower end. The path of the fuel is down two slots, transversely around the screw threads and down the alternate slots to the ball valve.

Injectors are mounted at an angle in the rear of the cylinder heads between the two valve ports, and the high-pressure fuel lines are all of considerable length.

To the extreme rear of the pump is strapped a float-and-pendulum type de-aerator. Fuel and air discharged from the pump feed into a pendulous casing swinging on a hollow shaft which serves as the air outlet. On the upper part of the pendulum a cork float slides on a ported sleeve. Whatever the attitude of the aircraft, flooding lifts the float to cut off the ports and prevents loss of fuel.



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AIRCRAFT TYPES AND

Lancaster and Flying Fortress II

CAPABLE of carrying a bomb-load of approximately eight tons, the Avro Lancaster ranks with the Short Stirling as one of the two most powerful vehicles of aerial destruction in the war against Axis aggression.

Having the same well-balanced lines as its smaller two-engined sister, the Manchester, the Lancaster is the outcome of more than 30 years of Avro experience, and is now being produced in large numbers in a variety of British factories and also in Canada. Incidentally, all records were broken by the speed with which the prototype Lancaster was evolved and the type launched into quantity production.

Despite its all-up operating weight of some 27 tons, this four-engined mid-wing bomber is remarkably manœuvrable and fully maintains the Avro reputation for nicety of control; its pilots describe it as particularly easy to handle.

Structurally, the Lancaster has been designed for ease of production, transport and of maintenance and repair. It lends itself to rapid and relatively cheap manufacture, being built up largely of self-contained units manufactured separately and easy to transport and assemble.

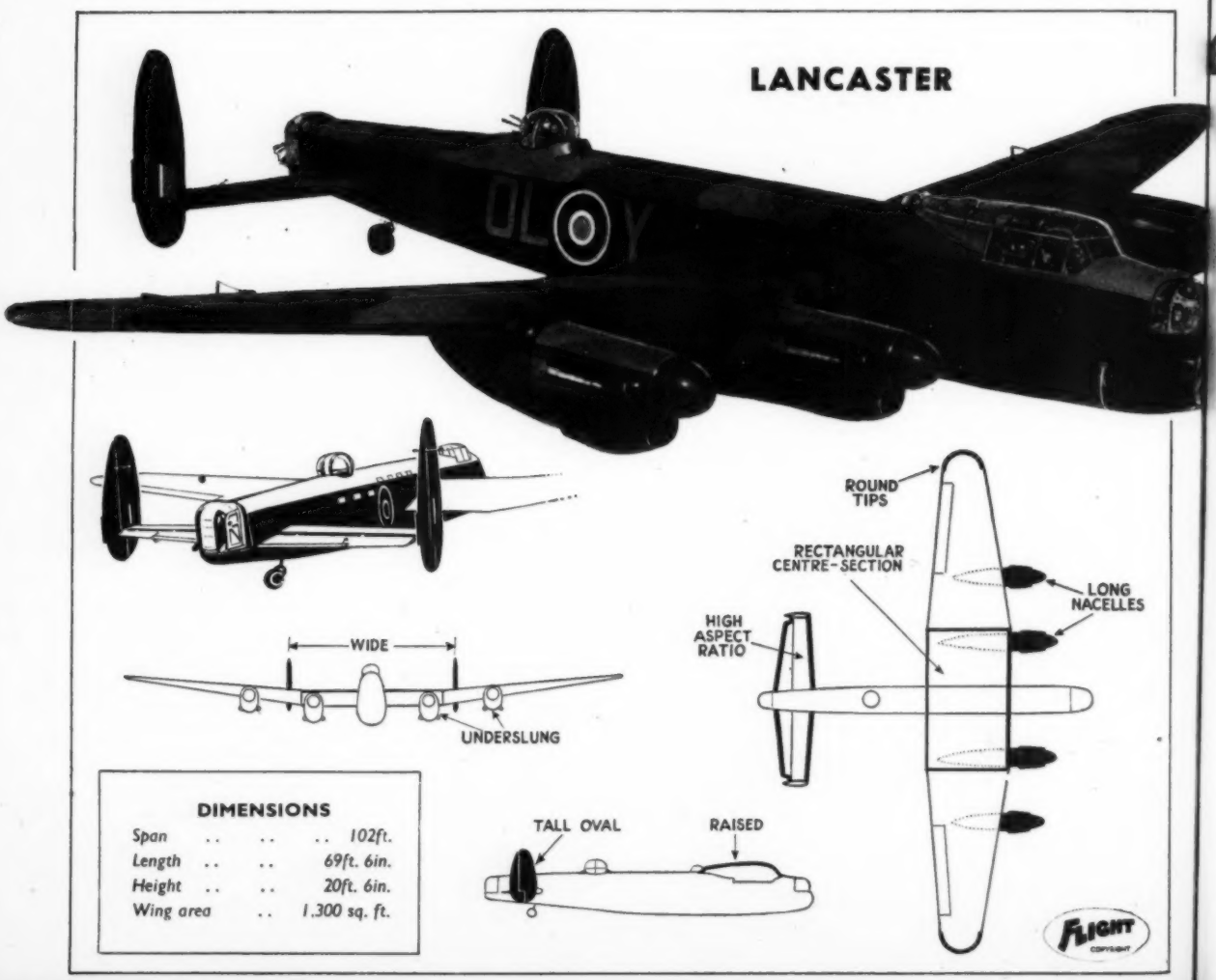
The fuselage is built up of transverse formers with continuous longitudinal stringers, and the wings are of two-spar construction, each spar consisting of top and bottom extruded booms bolted to a single, thick gauge web plate. Wing ribs are aluminium alloy pressings, and the tail plane is built up in similar fashion to the wings and has twin "end-plate" fins and rudders. The entire airframe is skinned with flush-riveted aluminium alloy sheets.

Defensive armament comprises four gun-turrets—nose, dorsal, ventral and tail—which together mount ten .303 Browning machine guns; the bomb-cell, with its hydraulically-operated doors, is 33ft. long, and an interesting point is that the electrical circuit of the bomb-release gear is so arranged that it cannot be operated until the doors are open. Both bomb-doors and undercarriage retraction gear can be operated by an emergency air system in case the normal hydraulic system should fail.

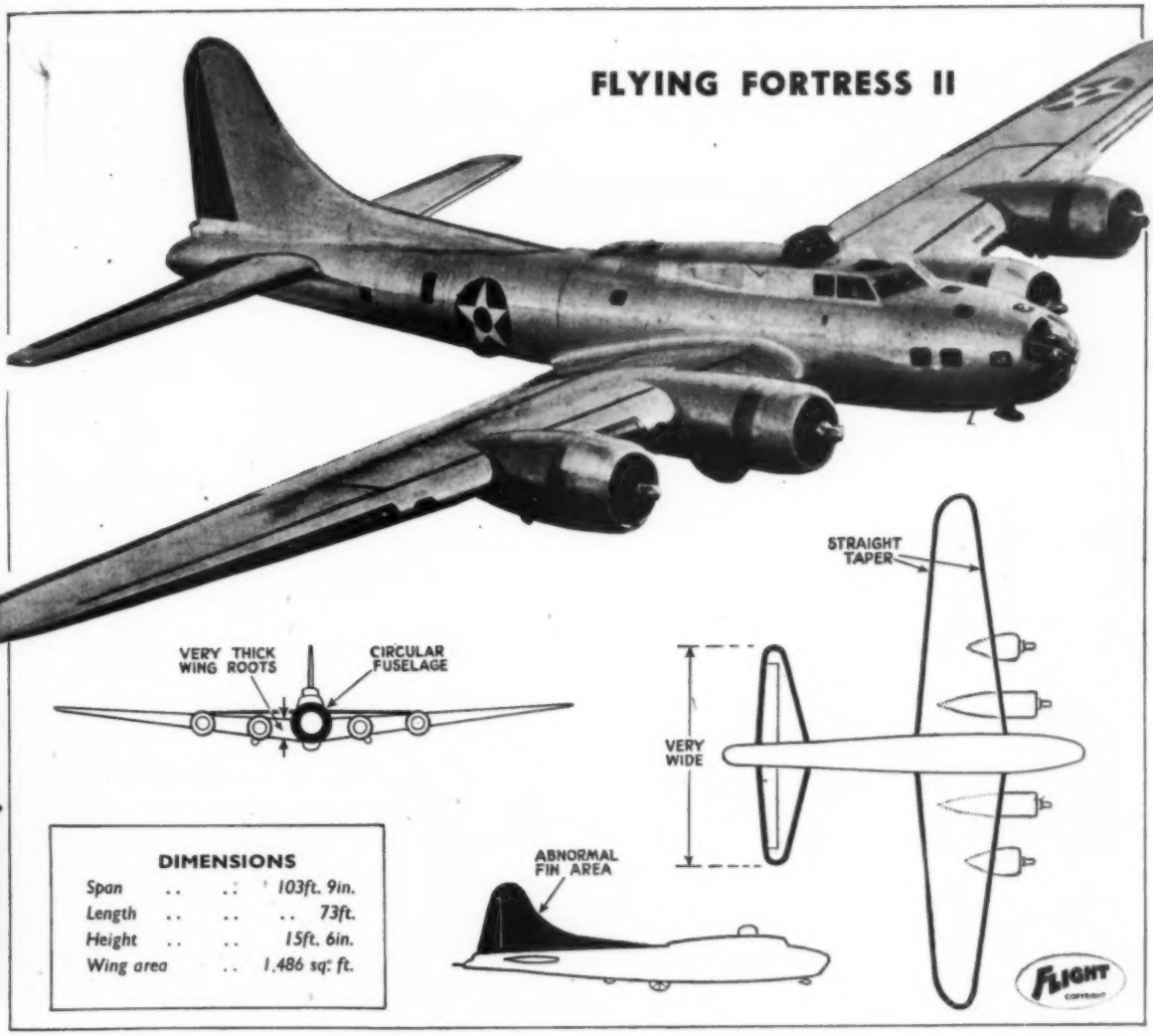
The Lancaster can carry a crew of seven, at each of whose stations there is an oxygen point, and de-icing equipment is also fitted.

Four Rolls-Royce Merlin XX 12-cyl. V-type liquid-cooled engines normally provide the power, but other engines, notably Bristol Hercules 14-cyl. double-row, sleeve-valve, air-cooled radial engines are also being fitted.

Top speed is about 300 m.p.h., and maximum range approximately 3,000 miles, but these, and the maximum bomb load, cannot all be obtained at the same time.



EIR CHARACTERISTICS



DIMENSIONS

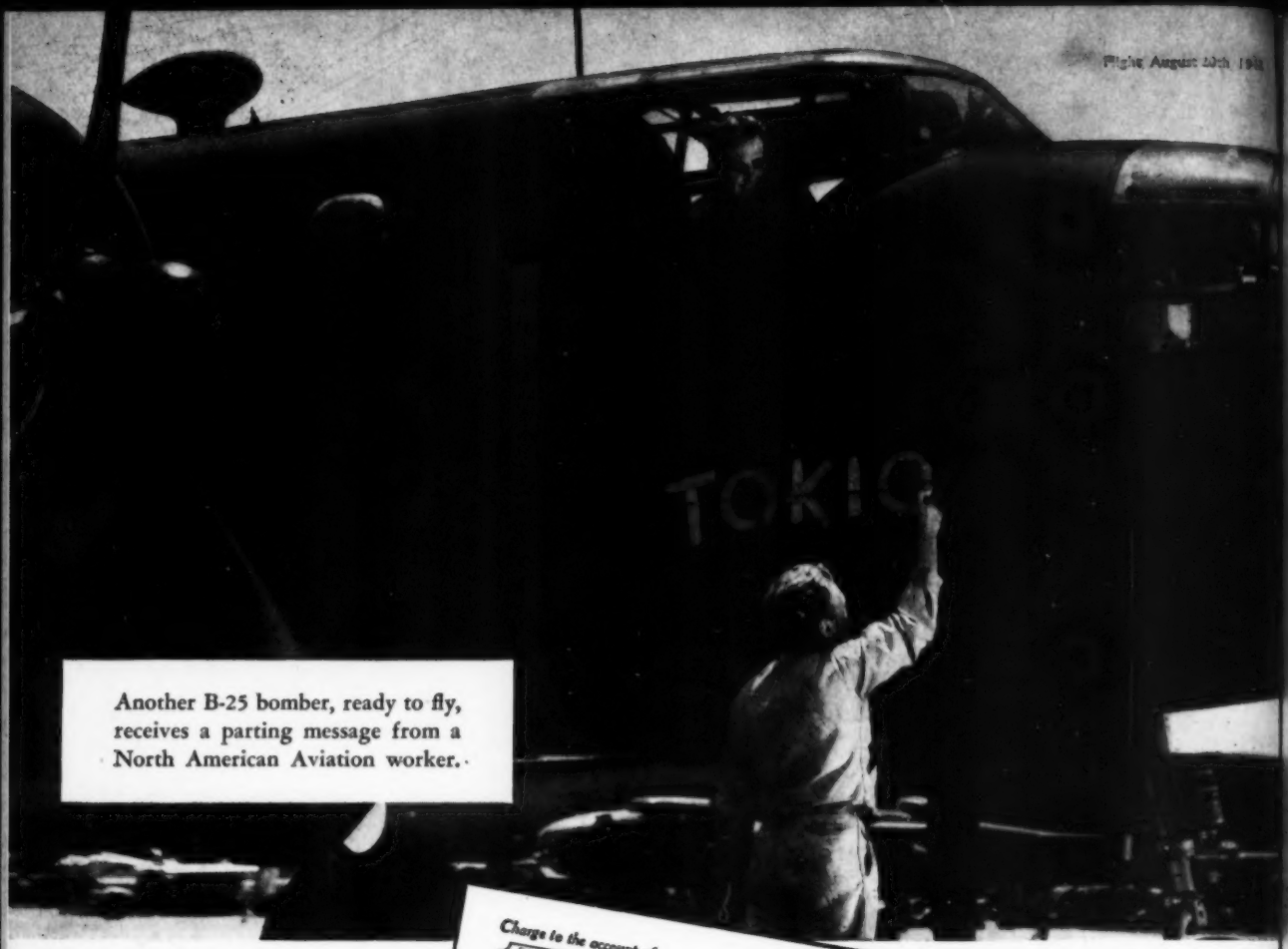
Span	103ft. 9in.
Length	73ft.
Height	15ft. 6in.
Wing area	1,486 sq. ft.

THE fifth in the Boeing B-17 series of heavy long-range four-engined bombers, the B-17E, known in this country as the Flying Fortress II, has a number of improvements over its predecessor, the B-17D, or Flying Fortress I. Chief of these from the operational point of view is its considerably strengthened armament, but the most obvious modification, and the one which most concerns the spotter, is the vastly increased fin area, the peculiar shape of which is apparent in the accompanying illustrations, and will be seen to reach forward, in a curve, halfway to the dorsal turret.

This increase in fin area was rendered necessary by the increase in the gross weight, the Fortress II totalling more than 50,000 lb., whereas the Fortress I scaled approximately 44,000 lb. The length of the fuselage in the newest Fortress is greater by 5ft. 2in. than that of its immediate ancestor, but, although longer and heavier, its wing dimensions remain the same; the span and area of the tailplane, however, have been substantially increased and, since the chord remains the same at the roots and the tips are equally small, it follows that the aspect ratio of the new tailplane is also greater. In contrast to the full-length elevators of the earlier types, the tips of the tailplane extend beyond the elevators on the B-17E.

Returning to the all-important matter of armament, the earlier B-17s hardly justified the title of "fortresses," the American designers having failed to appreciate the weight of fire-power necessary for a big bomber to defend itself adequately against the modern fighter in present-day warfare. But the Fortress II lacks nothing in this respect, having three power-operated gun turrets in addition to a gun position in the nose. These are situated above and immediately behind the pilots' cabin, in the extreme tail and below the fuselage just aft of the trailing-edge of the wings. The last named is retractable and the rear turret is really a remote-control post for guns projecting from the pointed extremity of the fuselage immediately below it.

Powered by four Wright 14-cylinder, double-row Cyclone engines of 1,200 h.p., fitted with exhaust-driven turbo-superchargers, the top speed of the Fortress II is said to be more than 300 m.p.h., although no official figure has yet been announced. Intended to cruise at 35,000ft., the service ceiling is probably of the order of 40,000ft., as its predecessor had a ceiling of more than 36,000ft. Maximum range is approximately 3,500 miles. The all-up weight is something approaching 25 tons, and the bomb-load is reported to be about 3 tons. It is designed to carry a maximum crew of nine.



Another B-25 bomber, ready to fly, receives a parting message from a North American Aviation worker.

"Each plane performed magnificently"

James H. Doolittle
Brigadier General
U. S. Army Air Forces

Charge to the account of

WESTERN UNION

Send the following message, subject to the terms on back hereof, which are hereby agreed to

THE EMPLOYEES OF NORTH AMERICAN AVIATION CO.
INGLEWOOD, CALIFORNIA

NOW IT CAN BE TOLD OFFICIALLY: WE BOMBED TOKIO IN THE NORTH AMERICAN BOMBERS YOU HELPED BUILD. EACH PLANE PERFORMED MAGNIFICENTLY, RACING TO ITS OBJECTIVE JUST OVER THE HOUSETOPS. THEN SHOOTING UP A FEW HUNDRED FEET TO DROP ITS BOMBS. OUR PLANES EASILY OUTMANEUVERED THE JAPANESE PURSUIT SHIPS. EVERY BOMB SEEMED TO SMASH INTO ITS TARGET. FLAMES POURED FROM THE ENEMY MILITARY AND NAVAL INSTALLATIONS AND ONE SALVO MADE A DIRECT HIT ON A NEW WARSHIP UNDER CONSTRUCTION. WE FLEW LOW ENOUGH AT TIMES TO SEE THE SURPRISED LOOK ON FACES IN TOKIO AND OTHER JAPANESE CITIES. EVERY ONE OF THE SEVENTY-NINE MEN ON THE FLIGHT JOINS ME IN PRAISING THE B-25. THE JAP PLANES COULDN'T DO A THING TO STOP US. THEY WILL NEVER STOP US IF YOU KEEP UP YOUR GREAT WORK.

JAMES H. DOOLITTLE, BRIGADIER GENERAL
U.S. ARMY AIR FORCES

NORTH AMERICAN *Sets the Pace*

BOMBERS FIGHTERS TRAINERS

For the United Nations B-25 (the "Mitchell") ★ For U. S. Army and RAF "Mustang" ★ For U. S. Army AT-6A . . . For U. S. Navy SNJ-3 . . . For RAF "Harvard"

FORTRESS SQUADRON

A Visit to One of the United States Army Air Force Units Now Stationed in Britain

Illustrated by "Flight" photographs.

ON A BRITISH AIRFIELD : A picture of a Fortress at a dispersal point. Some of the nose armament is evident ; the bomb doors are open and the ground staff are attending to the Studebaker-built Wright Cyclones.

THIS is no Hollywood air force. Anyone who has preconceived ideas of the U.S. air forces, gathered from the cinema and thought of in terms of New York's Broadway, can change his or her mind. The Americans are here in the field for a serious job of work and are living the part. Nevertheless they are an army of individualists. The station which we visited is one which has been taken over lock, stock and barrel from the Royal Air Force. In fact, some of the equipment is borrowed. The china and cutlery of the officers' mess bears the familiar R.A.F. marking and the petrol tankers at the dispersal points are also on loan.

At first sight one is likely to be misled by an air of casualness. The sentry at the gate has his automatic rifle slung butt uppermost from his shoulder, his hands may be in his pockets, yet even the people whom he knows by their Christian names must produce their identity cards before they are allowed to pass. The ground crews wearing their peculiar long-peaked jockey caps at every conceivable angle are just as efficient as the goose-stepping mechanics who tend the machines of the *Luftwaffe*.

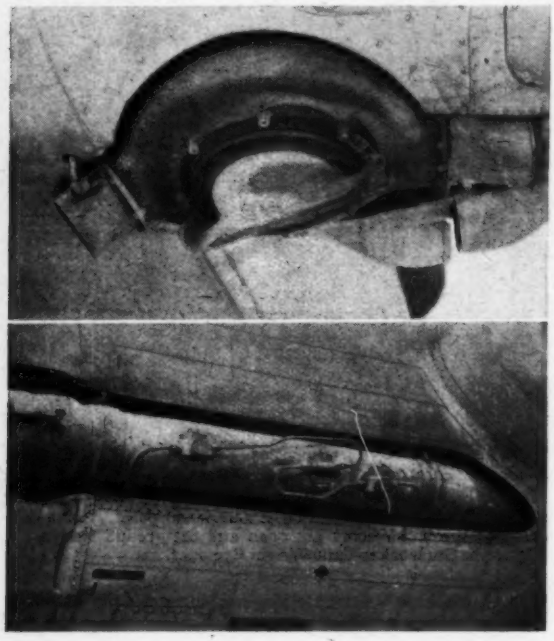
The flying crews are earnest young men who are very willing to talk of their hopes and listen to others in the hope of picking up operational tips. Some of the air crews have been posted to bomber squadrons of the R.A.F. in order to see how we tackle the problems which will soon be theirs. From one of these contacts comes a good story. An English pilot asked one of the attached Americans to draw a skunk for him. When this was done it was transferred to the pilot's Stirling with the motto underneath, "Now we are *really* offensive."

Moving In

Mobility of air power is exemplified by the way these U.S. Army squadrons move in to their stations in this country. Whereas our bombers have always been designed for hard hitting at a comparatively short range, the Americans have always had to think in terms of long distances. No enemy likely to matter could be within 2,500 miles, so the journey from the United States to England is but two flights of normal duration. This distance complex and the world-famous badness of Britain's

(Left) Two members of an air crew wearing their leather jackets and fur-lined boots which are similar to those worn by the R.A.F. (Right) In the ante-room. Officers in shirt-sleeves take their ease or read journals which come mostly from home.

FORTRESS SQUADRON

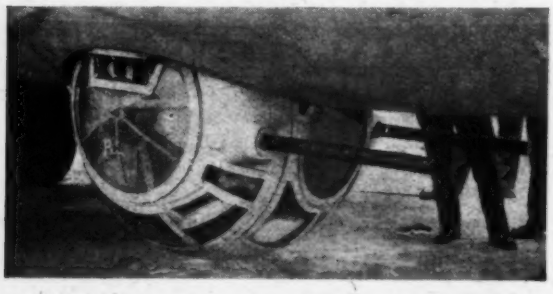


(Top) A close-up of the G.E.C. exhaust-driven turbo-supercharger. A butterfly throttle at the outlet controls the flow of exhaust gases through the turbine. (Below) Glycol boilers in the exhaust pipe which provide heating for the air crew stations.

weather is making them take extra care with their navigation. At first they were prone to overshoot by the odd hundred miles or so because they could not believe places could be so close together. Another slight trouble they have is multiplicity of landmarks. Back home, if they cross a straight main road or railway there can be no doubt as to its identification. Over Britain it is different; sinuous roads and railways every few miles make map reading difficult for a while.

They are proud of the new Boeing Fortress they fly and certainly it is operationally much improved on the original model we had over here. It is no longer defenceless. Thirteen machine guns are now fitted to cope with enemy fighters.

Some of the guns are in power-operated turrets—two in a Bendix dorsal turret and two in the Sperry spherical under the fuselage. Both of these turrets, in like manner to the undercarriage, flaps, bomb doors and other services are electrically operated. Self-sealing fuel tanks are fitted



The electrically-operated spherical Sperry ventral turret of the Fortress. It has two .5in. guns.

(Top) One of the .5in. machine guns mounted in the port side of the fuselage to look after quarter and beam attacks. (Centre) Until called into action the fuselage guns remain within the body and a panel covers the orifice through which they fire. (Bottom) An interior view showing one of the fuselage side guns in action and how the gunner is protected by vees of thick armour plate. The peculiar belt feed of .5 ammunition is also clearly shown. The ammunition carried is a mixture of tracer, incendiary and armour-piercing.

and the air gunners are protected by some useful vee-shaped slabs of armour plate. Despite this we feel that better crew protection is necessary and bulkheads of armour plate would be useful load well spent. We were shown over the whole of the Fortress with the exception of both extremities. The armament in the tail turret they are keeping up their sleeve, so to speak. In the nose is the Sperry bomb sight, famous for its secrecy, which legend has credited with the ability to drop a bomb in a barrel from 40,000ft. They do not show this to anybody.

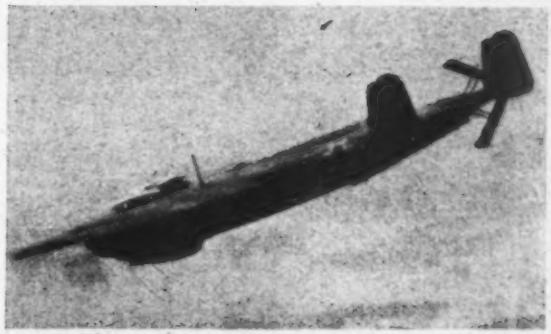
When these boys get going, in addition to the ever-increasing weight of the Royal Air Force attack, Germany will be a country in which it will be lucky to live!

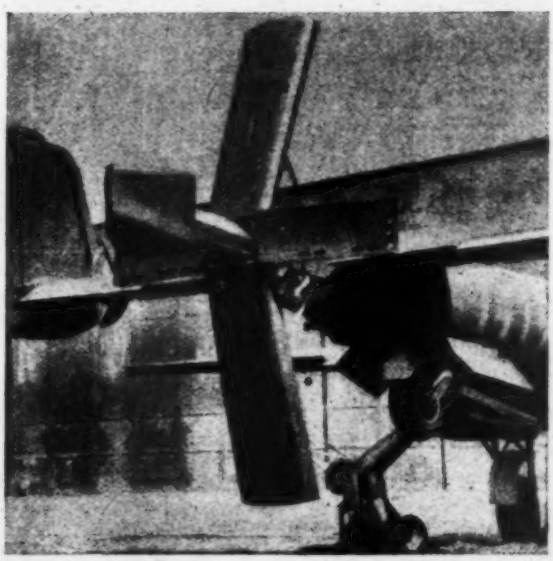
DORNIER DIVING BRAKES

Air Photographs of the Umbrella Brake in Action

A DETAILED description of the structure of the diving brake fitted on the Dornier Do.217E was published in *Flight* of July 2nd, 1942. Here are the first air pictures of this brake in operation. In the photograph below it is shown in the fully closed and also in the fully opened positions. When closed it gives the appearance of an extended tail unit.

The brake is controllable in flight, and operates in several phases, as is shown in the series of four photographs on the right. The opening up is regulated according to the desired angle of dive. The wider open the brake is set the more pronounced may be the diving angle of the machine. At the maximum permissible diving angle of the Dornier Do.217 the brake is opened to its full extent. In this case the aircraft is then capable of diving at a speed of 430 to 490 m.p.h.





IN PARLIAMENT

Shoulder Flash Difficulties : R.A.F. Private Petrol Ration : Meetings in Protected Places : Going "Foreign" in Britain : Considering the Small Builder

Colonials' Shoulder Flashes

Capt. Gammans asked the Secretary of State for Air whether he is prepared to reconsider his decision and allow men who have come from the Crown Colonies to wear a shoulder flash bearing the name of their Colony and thus follow the practice accorded to men from the Dominions and the United States of America.

Capt. McEwen (*Lord of the Treasury*): I have been asked to reply. This suggestion has been considered on several occasions and is again under consideration at the present time. The administrative and other difficulties are, however, considerable and may prove to be insurmountable. My hon. and gallant Friend will be informed of the outcome in due course.

Petrol Allowance for R.A.F.

Flt. Lt. Boothby asked the Secretary of State for Air whether he will consider the possibility of issuing a basic petrol allowance to the Royal Air Force of 200 miles a quarter, instead of the present allowance of 250 miles for leave only.

Capt. McEwen : No, Sir. My right hon. Friend regrets that he does not feel that an increase in the existing scale of allowance would be justifiable in present circumstances.

Flt. Lt. Boothby : Will my hon. and gallant Friend ask his right hon. Friend to consider the possibility of issuing an even lower mileage allowance than that suggested in the question if the supplies of petrol are limited, on the grounds that it would be very much more useful to Air Force personnel employed on stations, which are often isolated, as against using petrol for leave purposes which is both extravagant and unnecessary?

Capt. McEwen : Yes, Sir.

Factory Literature and Meetings

Mr. David Adams asked the Secretary of State for Air whether he is aware that certain workers in an aircraft factory which had been declared a protected place were prosecuted on May 26 for distributing literature in the factory which entailed dismissal upon the grounds of serious misconduct; and whether the customary right of the workers to distribute literature and to hold meetings will be preserved in such protected places in future.

The Secretary of State for Air (*Sir Archibald Sinclair*): Yes, Sir. The directions which my hon. friend has in mind are of common application to all factories which are protected places, and they have been made in the interests of war production. They prohibit the distribution of literature with certain exceptions, such as works notices, works magazines, trade union journals and publications and Government publications. They also prohibit the holding of meetings in protected places without permission.

Mr. Adams: Is it a matter of serious urgency to stop the old privileges of the workmen to have a meeting and distribute their own literature relating to shops stewards?

Sir A. Sinclair: These orders have long been in operation. They are in the interests of war production, and they have never been challenged.

Posting Airmen

Mr. Liddall asked the Secretary of State for Air whether in future postings to stations in these islands more regard will be had to the locale of the men's home so that Highland Scots will no longer be posted to the South of England while Southern Englishmen are posted to remote parts of Scotland.

Sir A. Sinclair: I would refer my hon. Friend to the reply given to my hon. Friend the Member for Chislehurst (Sir W. Smithers) on May 5th.

Mr. Liddall: Does not my right hon. Friend agree that, psychologically, this is a very bad thing? Many men find themselves posted to parts where they feel that they are in a foreign land, the language of which they do not understand. Does he not feel that he should consider this question of long railway journeys and the unnecessary use of railway accommodation, with this useless expenditure of time and money?

Sir A. Sinclair: Initial postings are decided by the requirements of the Service on the one hand and the qualifications of the individual on the other. Once the initial postings have been made, changes are avoided as much as possible; but in making these postings we consider, as far as possible, the posting of a man near to his home; and after the initial posting has been made, if a man has good compassionate grounds for asking for posting to his home, we do our best to meet his requirements.

Mr. Liddall: Why should a Cockney be posted to a remote Scottish island?

Building Contracts

Mr. Lipson asked the Secretary of State for Air why, in placing contracts for several million pounds recently, the Builders' Emergency Organisation, set up by the Ministry of Works and Planning, has been ignored; why local builders were not given the opportunity to tender; and why the contracts were all given to a few firms, such as Wimpey's and McAlpine's and their subsidiaries?

Sir A. Sinclair: The contracts to which I assume the hon. Member refers were placed after consultation with the Ministry of Works and Planning, who consult the Builders' Emergency Organisation whenever they think it appropriate. Of the 52 firms invited to submit tenders, 15 were local firms. Of the 22 contracts allotted, six were allotted to Wimpey and two to McAlpine. So far as I know, the 12 successful tenderers in the case of the remaining 14 contracts included no subsidiaries of these two firms.

Mr. Lipson: Is my right hon. Friend aware that many of these contracts were placed without the Builders' Emergency Organisation being consulted; and that in many areas local builders were not allowed to tender, and that they have a feeling that this policy, if persisted in, will drive them out of business?

Sir A. Sinclair: No, Sir. On these large contracts it is my duty to consult with the Ministry of Works and Planning, and it is for them to decide whether it is appropriate to consult the Builders' Emergency Organisation or not. In the case of smaller contracts, of £20,000 or less, which my officers have power to allot, we do consult the Builders' Emergency Organisation.

Mr. Lipson: Have the arrangements for the placing of these contracts the approval of the Ministry of Works and Planning?

Sir A. Sinclair: Yes; I said that we consulted the Ministry of Works and Planning.

Capt. Sir Derrick Gunston asked the Secretary of State for Air whether, in placing contracts with a few large firms only, he is satisfied that he has carried out the undertaking given to this House some time ago that local builders would be given the opportunity for contracting in their area; and is he aware that many local builders are losing their employees to the larger contractors?

Sir A. Sinclair: It is not the general practice of the Air Ministry to place contracts with a few large firms only. When tenders are invited, every consideration is given to the claims of local firms capable of executing the work. If such firms submit satisfactory quotations they are given contracts. The transfer and distribution of labour generally is a matter for my right hon. Friend the Minister of Labour and National Service.

Sir D. Gunston: Is not my right hon. Friend aware that in many cases small firms, owing to the Ministry giving work to the large firms, lose their machinery and their men, who are very often transferred to the large firms and find that they have no work to do for many days?

Sir A. Sinclair: We are only anxious to get the work done, and we have to get it done at the lowest rate we can, but we have to choose the firm which we know has the power and the experience to enable it to get important work done in time for the operations for which it is required.

Mr. Leslie: Is it not a fact that many of these large firms have not the plant and that they commandeer it?

Mr. McKinley: How does the right hon. Gentleman ascertain the cheapest contract that is possible?

Sir D. Gunston: Is my right hon. Friend prepared to receive a deputation on this matter, which is very important?

Sir A. Sinclair: Certainly, I am always ready to discuss these matters with my hon. Friends.

ESTIMATING TAKE-OFF WEIGHT—II

Calculations for a Heavy Bomber Design

By W. NICHOLLS, A.R.Ae.S.

OBTAINING an accurate estimate of the take-off weight for a new heavy bomber project is a more difficult proposition than for the single-seater fighter considered in the previous article on this subject. In the latter case values of $\frac{\text{Removable Load}}{\text{Fuel and oil (lb.)}}$ for a given fuel capacity plotted against values for take-off weight proved reasonably accurate for practical use to within ± 2.5 per cent.

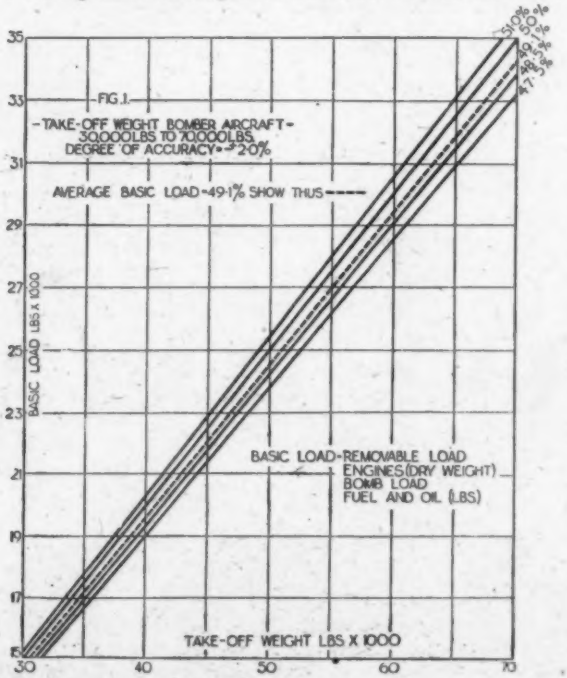
This method obviously could not apply to the bomber with the additional loads to be carried, which necessarily influence the result. In addition to the two loads already mentioned for the fighter case, the bomb load must occupy attention in this case. To assist in finding the take-off weight this load is very misleading, inasmuch as for two identical aircraft of the same gross weight the bomb load varies as much as 50 per cent. Also for a bomber, say, of 50,000 lb. gross weight the bomb load is sometimes greater than for a bomber of, say, 66,000 lb. gross weight.

To refer again to the two identical bombers of the same gross weight, one naturally assumes that the variation in bomb load would be balanced, by the fuel and oil load, but here again the fuel and oil load can be the same in both cases. The bomb load, therefore, is not helpful to any great extent in estimating the take-off weight. It must, however, be taken into account.

This means that another known load must be considered to balance the difference, and it is found that the engine (dry weight) assists materially in this respect.

To provide a reliable and accurate method for obtaining the take-off weight in the case of the heavy bomber, four known loads from the specification should, therefore, be used, viz.: (*a*) Removable load; (*b*) engine (dry weight); (*c*) bomb load (less carriers); (*d*) fuel and oil (lb.). For the purpose of this article these four loads added together will be termed the "basic load" and will be referred to as such hereafter; thus $a+b+c+d$ = basic load.

During these investigations it was found that the basic load remained fairly constant as a percentage of the take-off weight for all aircraft within this category, *i.e.*, 30,000 lb. to 70,000 lb. gross weight, the average being basic load = 49.1 per cent. of take-off weight.



In Fig. 1 is plotted average data basic load against take-off weight, 49.1 per cent. being shown in chain dot. Where a rapid estimate is required, therefore, and a close degree of accuracy is not immediately essential, the take-off weight for a given basic load can be read direct from Fig. 1 for 49.1 per cent. The degree of accuracy from such a method is not, however, good enough for practical use in a new project, being no nearer than ±5 per cent.

From the four known loads comprising the basic load it was hoped to find some indication whereby one or other of the curves shown in Fig. 1, or an intermediate, could be selected. By doing so obviously the take-off weight could be found sufficiently accurately to be of practical use.

The basic load as a percentage of the take-off weight varies between 47 per cent. and 51 per cent. of the take-off weight, the average being, as previously stated, 49.1 per cent. These percentages are plotted in Fig. 1.

FIG. II

Removable Load (a)		Engines (Dry Wt.) (b)		Bombs (c)		Fuel and Oil (d)	
(a) % Basic Load	(e)	(b) % Basic Load	(f)	(c) % Basic Load	(g)	(d) % Basic Load	(h)
10.0	47.0	19.0	48.0	10.0	47.0	32.0	47.0
10.5	47.3	19.4	48.2	12.0	47.3	33.3	47.3
11.0	47.5	19.7	48.3	13.5	47.5	34.5	47.5
11.2	47.7	20.1	48.4	15.5	47.8	35.8	47.8
11.4	48.0	20.4	48.5	17.0	48.0	37.0	48.0
11.8	48.3	20.8	48.7	18.5	48.2	38.3	48.3
12.1	48.5	21.1	48.8	20.3	48.5	39.5	48.5
12.5	48.8	21.4	48.9	22.3	48.8	40.8	48.8
12.8	49.1	21.7	49.1	23.5	49.1	42.0	49.1
13.6	49.3	22.2	49.3	25.0	49.3	44.0	49.3
14.3	49.5	22.6	49.5	26.5	49.5	45.6	49.5
15.1	49.8	23.1	49.8	28.0	49.8	47.5	49.8
15.9	50.0	23.6	50.0	29.5	50.0	49.0	50.0
16.7	50.3	24.1	50.3	31.0	50.3	51.0	50.3
17.4	50.5	24.5	50.5	32.5	50.5	52.5	50.5
18.2	50.8	25.0	50.7	34.0	50.8	54.5	50.8
19.0	51.0	25.5	51.0	35.5	51.0	56.0	51.0

To select the ideal curve in Fig. 1 the following system proves to give accurate results. Each load *a*, *b*, *c*, and *d*, is tabulated as a percentage of the basic load. Representative values of such percentages of the basic load were then found for the take-off weight. These values have been tabulated in Fig. 2 under their respective loads, the left-hand column in each case representing the load as a percentage of the basic load. Opposite this is the representative value for the take-off weight (*e*), (*f*), (*g*) and (*h*) respectively. Before final selection of a curve can be made in Fig. 1 it becomes necessary to average the values for the loads thus $\frac{e+f+g+h}{4}=x\%$, from which the curve in Fig. 1 or an intermediate can be selected

Actually the take-off weight can by this means be calculated without reference to Fig. 1, all *x* per cent. being the percentage of the basic load to the take-off weight in each case.

The method has been checked for a number of aircraft within the category of a heavy bomber of which weight data have become available, and the degree of accuracy was found to be −1.8 per cent., +1.6 per cent.

Application

As an example of how the method can be applied in practice, assume from the specification of a new project for a four-engined heavy bomber the four loads are as follows: (*a*) removable load = 3,750 lb.; (*b*) four engines (dry weight) = 5,900 lb.; (*c*) bomb load = 4,000 lb.; (*d*) fuel and oil = 16,700 lb.

ESTIMATING TAKE-OFF WEIGHT—II

Basic load = $a+b+c+d$ = 30,350 lb.

As a percentage of the basic load, a = 12.3 per cent.; b = 19.4 per cent.; c = 13.2 per cent.; and d = 55.1 per cent. From the table in Fig. 2, corresponding values for the above percentages are e = 48.65; f = 48.2; g = 47.45; and h = 50.9.

$$\therefore \frac{48.65+48.2+47.45+50.9}{4} = 48.8 \text{ per cent.}$$

In this case basic load = 30,350 lb. = 48.8 per cent. of take-off weight which calculated gives take-off weight = 62,190 lb. From intermediate curve in Fig. 1 for basic load of 30,350 lb., take-off weight = 61,300 lb. Direct calculation should, of course, be the most accurate.

HEAVY BOMBER AIRCRAFT — DISTRIBUTION OF WEIGHT				% TAKE OFF WEIGHT 50,000 TO 60,000	% TAKE OFF WEIGHT 60,000 TO 70,000
TAKE-OFF WEIGHT					
BASIC OPERATIONAL EQUIPPED WEIGHT					
TARE WEIGHT					
BARE WEIGHT					
STRUCTURE	WINGS		WINGS COMPLETE	11·9	12·85
			ENGINE MTG. AND NACELLE STRUCTURE	2·8	2·5
			ENGINE AND NACELLE COWLINGS	1·8	1·0
			MAIN UNDERCARRIAGE UNIT	3·9	4·45
			TOTAL - WING UNIT	20·4	20·8
	TAIL		TAILPLANE AND ELEVATORS	1·0	1·22
			FIN AND RUDDER	0·45	0·43
			TOTAL - TAIL UNIT	1·45	1·65
	FUSELAGE		FUSELAGE	10·8	8·4
			TAILWHEEL UNIT	0·35	0·35
			TOTAL - FUSELAGE	11·15	8·75
			TOTAL - FLYING CONTROLS	0·6	0·6
			TOTAL FOR STRUCTURE	33·6	31·8
POWER PLANT	POWER UNIT		ENGINES (DRY WEIGHT)	9·9	11·2
			AIRSCREWS (COMPLETE)	2·5	2·8
			ACCESSORIES	2·6	3·9
			TOTAL - POWER UNIT (RADIALS)	15·0	17·9
	FUEL SUPPLY		FUEL TANKS (BARE - UNPROTECTED)	2·0	1·24
			FUEL SYSTEM	0·5	0·48
			OIL TANKS (BARE - UNPROTECTED)	0·15	0·2
			OIL SYSTEM	0·85	0·45
			TOTAL - FUEL SUPPLY UNIT	3·5	2·35
			TOTAL - POWER PLANT (RADIALS)	18·5	20·25
			TOTAL - BARE WEIGHT	52·1	52·1
	PROTECTION AND FIXED LOAD		PROTECTION		
			FIXED ARMAMENT	7·5	9·5
			FIXED LOAD		
			TOTAL - TARE WEIGHT	59·6	61·6
	REMOVABLE LOAD		REMOVABLE ARMAMENT		
			REMOVABLE EQUIPMENT	6·4	6·4
			CREW		
			TOTAL - REMOVABLE LOAD	6·4	6·4
			TOTAL - BASIC OPERATIONAL EQUIPPED WEIGHT	66·0	68·0
	BOMBS, FUEL AND OIL		BOMBS		
			FUEL	34·0	32·0
			OIL		
			TAKE-OFF WEIGHT	100·0	100·0

Fig. 3. Average weight distribution as percentage of take-off weight for bomber aircraft.

FIG. IV

Liquid Cooled Power Units. Heavy Bomber Aircraft — Weight Distribution	% Take-off Weight: Under 50,000 lb.	% Take-off Weight: Over 50,000 lb.
Power Unit—		
Engines (dry weight)	10.0	10.2
Airscrews (complete)	2.85	2.9
Radiator, cowling, liquid, system	2.3	2.4
Accessories	1.95	2.5
Total Power Unit (liquid cooled)	17.10	18.0

As an example at the opposite end of the scale, a twin-engined bomber, assume from the specification the four known loads to be: (*a*) removable load = 4,000 lb.; (*b*) two engines (dry weight) = 4,600 lb.; (*c*) bomb load = 6,000 lb.; (*d*) fuel and oil = 7,530 lb.; from which basic load = 22,130 lb., and as a percentage of the basic load, (*a*) = 18.1; (*b*) 20.8; (*c*) 27.1; and (*d*) = 34.0. Substituting representation values from Fig. 2, *e*, *f*, *g*, *h*, respectively, will give $\frac{50.7+48.7+49.6+47.4}{4} = 49.1$ per cent.

Incidentally, this corresponds with the average load, and by direct reading from Fig. 2, take-off weight = 45,100 lb. for basic load as stated.

Once the take-off weight has been established the weights can be distributed for each unit and component according to the chart in Fig. 3. Where the power unit is liquid-cooled, slight modification can be made by using the alternative in Fig. 4.

It is possible in certain cases, where such loads as protective items or freed armament are above the average, that some slight adjustment may be necessary, but in any case the chart will assist materially in this respect.

As with the fighter considered in the previous article, it is recommended that once the weights have been distributed they should be issued to the drawing office so that during the detail design every care is taken that such estimates are not exceeded.

Other data which may be of interest in connection with weight estimates for bomber aircraft are:—

Average wing weight per sq. ft. of net area, but including flaps and ailerons (50,000 to 70,000 lb. gross wt.) = 6.5 lb. per sq. ft.

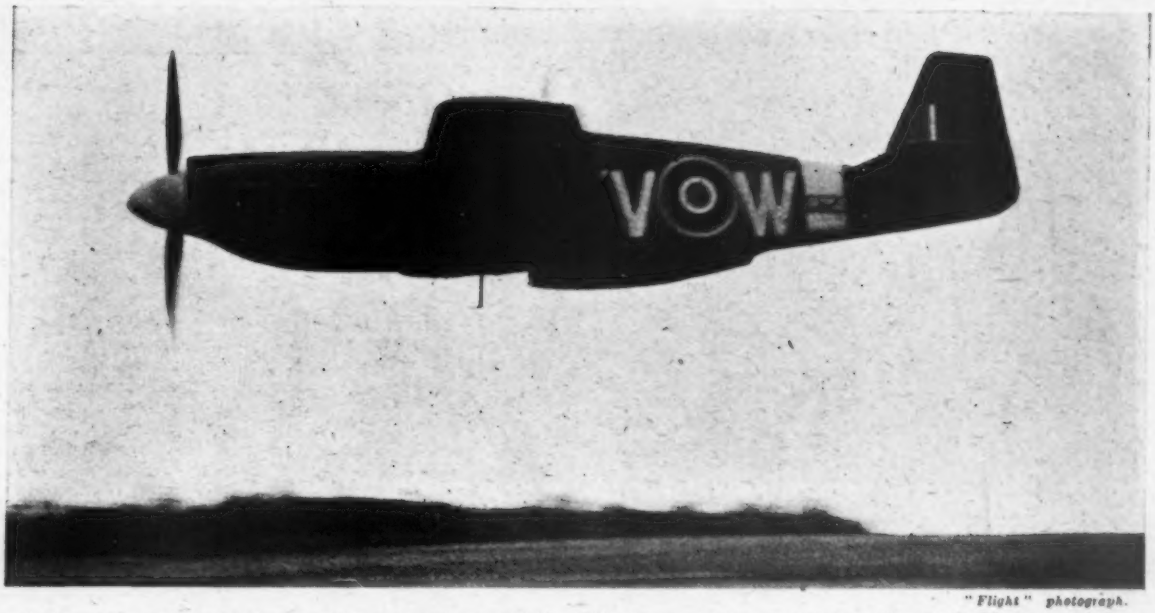
Fuel tank weights seem to vary per gallon capacity from 0.9 lb. for approx. 900 gallons total fuel capacity to 0.5 lb. for approx. 2,000 gallons total capacity.

Oil tankage weight appears constant at 0.8 lb. per gallon capacity.

Wing loading varies from 38.0 to 48.0 lb./sq. ft. Span loading, 370 lb. to 700 lb. per foot span.

Power loading varies from 10.0 to 15.5 lb. per h.p.

An army co-operation Hurricane of the R.A.F. about to drop a message at headquarters during exercises with a New Zealand Division in Syria.



"*Flight*" photograph.

An Army Co-operation Mustang on a low reconnaissance flight. This view emphasises the straight lines of the Mustang and the disposition of the tailplane surfaces.

UNOBTRUSIVE CLEVERNESS

A Fighter Design Which Merits Close Study: North American Mustang Embodies Many Interesting Features

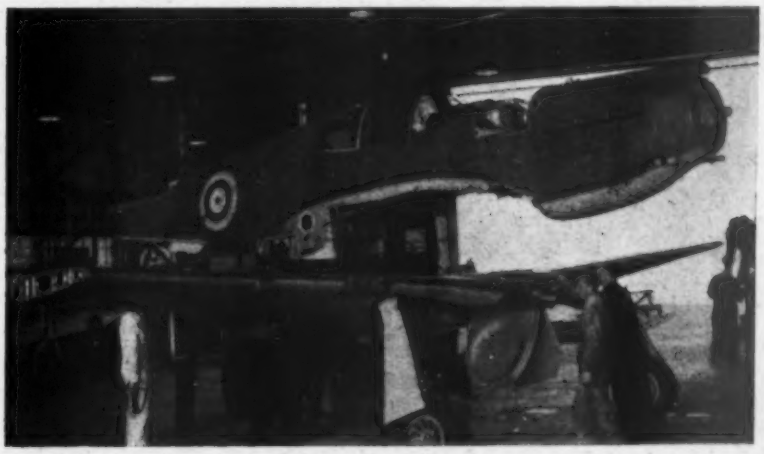
NORTH AMERICAN MUSTANG (N.A. 73)

WING SPAN: 37ft. 3in. Wing area: 236 sq. ft.
LENGTH: 31ft. 3in.
HEIGHT (at rest): 8ft. 8in.
UNDERCARRIAGE: Wide Track (11ft. 10in.), fully retractable inwards. Tail wheel also retractable.
ENGINE: One liquid-cooled Allison inline type F.3.R. of 1,150 h.p. with single-stage supercharger.
AIRSCREW: Hamilton 3-blade, constant-speed type.
RADIATOR: Special dual purpose design for both glycol and oil cooling.
SPEED: No details available, but certainly the fastest Army Co-operation aircraft in service anywhere.
ARMAMENT: Two machine guns synchronised to fire through airscrew, two machine guns in each wing.

IN the pioneering days of flying we used to say that if an aircraft *looked* right, it *was* right. The saying had a deal of truth in it, but not, of course, the whole truth, and it might have been more to the point to have said that if it *looked* wrong it *was* wrong. We are reminded of these contemplations by the North American Mustang, which has now gone into service with Army co-operation squadrons of the R.A.F. This fighter, which bears the works type numbers NA-73 and is known to the U.S. Army Air Forces as the P-51, is one of the most handsome fighters in existence. And in this instance it not only *looks* right, it *is* right.

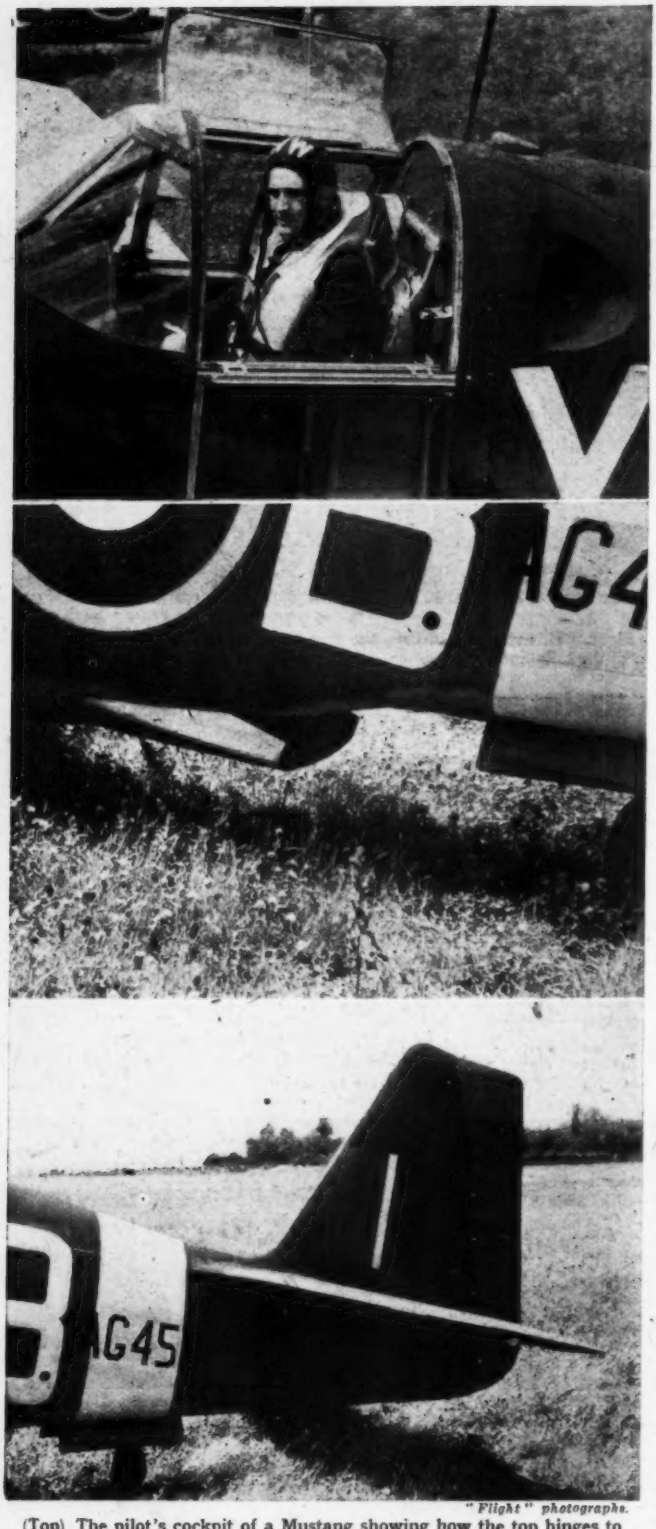
There was a time when this excellent aircraft came near being a square peg in a round hole, but fortunately its merits were realised in time, and it was allocated to Army co-operation work,* for which its 1,150 h.p. Allison engine with single-stage blower makes it eminently suited. In point of fact, with a two-stage blower and more powerful engine, there appears to be no reason why the Mustang should not do equally well on other duties.

The Mustang is a product of North American Aviation, Inc., of Inglewood, California. The same firm produced the B-25 Mitchell, the high-speed medium bomber used in the raid on Tokio. Comment is often heard on the similarity in outline between the Me 109 and the Mustang. This similarity, which is superficial only, may be accounted for by the fact that in the year when the Mustang was designed, the chief designer of North American was Mr. E. Schmued, who is reported to have spent, in his younger days, several years in the drawing office of Willy Messerschmitt. The rather remarkable thing about the Mustang



A North American Mustang, fresh from its packing case, being erected at a British airfield. The port and starboard wings are bolted together and the fuselage lowered into position. The upper wing surface thus becomes the cockpit floor.

* An article on the Mustang in service with an Army Co-operation squadron appeared in *Flight* of July 30th.



"Flight" photographs.

(Top) The pilot's cockpit of a Mustang showing how the top hinges to the right and the port side drops downwards. The side panels can be opened. In the windscreen is a large bullet-proof glass panel and a big slab of armour plate protects the pilot from the rear. (Centre) The variable opening under the fuselage which controls the quantity of air passing through the radiator. (Bottom) The tail surfaces and retractable tail surfaces which have such a distinct likeness to the Me. 109.

UNOBTRUSIVE

is that one finds it difficult to make up one's mind whether it gets its good looks from the straight lines or in spite of them. The biplanes designed in the old days by G. H. Handasyde were considered very good-looking, and they had many straight lines.

Be that as it may, a very great deal of care has been taken in the design of the Mustang. To begin with, it makes use of one of the wing sections developed as a result of extensive research by the American National Advisory Committee for Aeronautics into laminar flow. It is by now well established that over the front portion of a wing section the flow is laminar unless disturbed by roughness or excrescences. At small angles it may be laminar over almost the entire section, but as the angle of incidence increases, the chances are that over the trailing portion of the section the flow may become turbulent. This type of flow causes extra drag, and when the turbulence becomes severe stalling may occur in the spreading of the turbulence over adjacent areas.

In the case of the Mustang, great care has been taken to secure laminar flow by making the surface as smooth as possible, not merely over the leading-edge portion but throughout. Flush riveting and smooth joints between plates are means to this end, but one wonders how much of the effect is spoilt by the camouflage painting. Aircraft used for night flying, which have to have the underside of the wings painted a dead matt black, are certainly slowed down appreciably. The day-flying camouflage is less rough.

Wing Thickness

Another source of drag is provided by small air leaks between fixed and movable surfaces, or between ill-fitting doors and their frames. An examination of the Mustang reveals that at all such points only very small gaps are tolerated. In the case of the wheels of the undercarriage, doors hinged on the bottom centre line of the fuselage close the openings over the wheels and make an airight joint with the wheel strut fairings and the lower wing surface, so that when the machine is flying with the undercarriage retracted, the surface is perfectly smooth.

In addition to a smooth surface, the drag of an aircraft wing is also influenced by thickness. Although we have no figures for the Mustang, in the form of thickness/chord ratio, it is obvious that the wing is very thin, with a fairly sharp nose, both features which are suitable for a high-speed wing.

When we first began to use the low-wing monoplane arrangement it was soon discovered that a lot of interference drag between wing root and fuselage was caused if the fuselage had rounded sides. This may be visualised by thinking of the air stream having to expand as it reaches the maximum ordinate of the wing section. The trailing-edge portion of the wing curves downwards, and the fuselage sides inwards. The resulting turbulent airflow not only caused extra drag, but in many cases gave rise to tail buffeting. For a time the cure was found in using large wing fillets between the wing root and the fuselage. In some machines these reached almost ridiculous proportions, and extended well towards the tail. With greater experience it was found that there were less extreme ways of attaining the same ends.

The wing/fuselage joint of the Mustang is

USI[L]EVERNESS

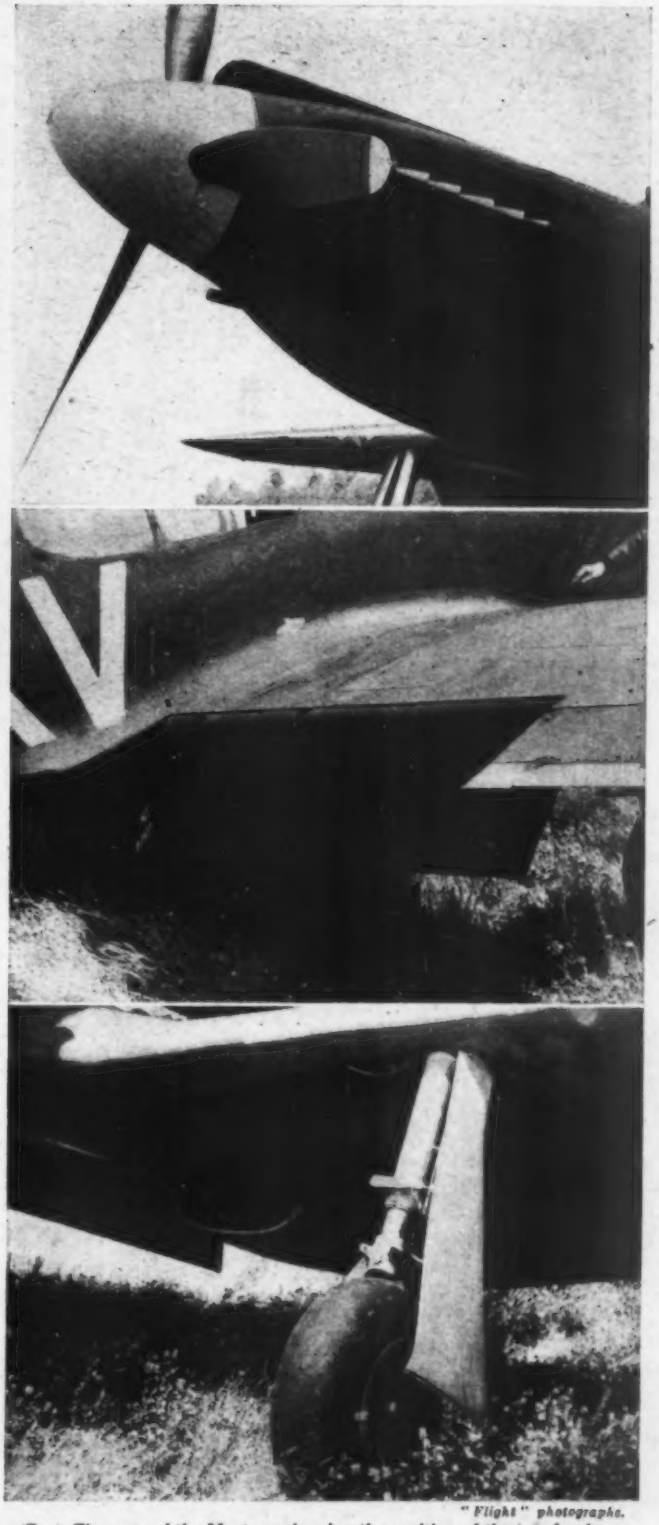
A close-up view of the snug fitting doors and retractable tail wheel of the Mustang. In common with American practice a single member is employed instead of a fork to hold the axle.

worth studying. It has been mentioned above that a thin wing section is used. Near the root there is a fairly sudden increase both in thickness and chord, the former being on the under surface and the latter on the leading-edge. In this way it has been possible to avoid large fillets on the upper surface, on which the radius of the fillet is quite small except at the extreme trailing-edge. What probably helps to make this possible is the placing of the radiator under the fuselage, the cowling beginning under the wing and ending some way behind it, in a movable cowl which controls the cooling.

Tail Arrangement

The only other feature of the aerodynamic design of the Mustang which appears to call for comment is the arrangement of the tail. The tailplane and elevators are placed wholly ahead of the rudder, doubtless with the object of preventing "blanketing" of the rudder at large angles of incidence. Thus the rudder should be more powerful in the region of the stall. What still further helps to make the whole stern portion of the fuselage "clean" is the placing of the tail wheel much farther backward than is usual practice. True, the tail wheel retracts, but the doors may have small air leaks, and anyway, the forward placing of the wheel makes it possible to have the stern portion of the fuselage extremely fine, so that the airflow leaves it cleanly.

For the work it has to do, the Mustang is fortunately very robust. Army co-operation flying means battlefield airfields with—at the best—only wire mesh runways. If under these conditions a machine is to operate and cope on equal terms with enemy fighters, it has to be a very good aircraft indeed.



"Flight" photographs.

(Top) The nose of the Mustang showing the position of the two fuselage guns which are synchronised to fire through the propeller disc. (Centre) The wing flaps of the Mustang in the down position. Owing to the flap being brought close to the fuselage there is no step, and ingress to the cockpit is by way of the front wheel and leading edge. (Bottom) The inward-retracting undercarriage. The inner cowling opens in order that the wheel can pass. The ducted radiator under the body is also apparent.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

THE MODERN AMAZON

Should Women be Fighter-pilots?

NO doubt the recent correspondence in the Press regarding the question whether women should be trained as fighter-pilots or not has come to your notice. I am one of the many girls whose sole ambition is to fly, and so, if a scheme enabling women to fly and fight in aerodynes was organised, it would be, I am convinced, invaluable to England, even if it included only a few women.

I was told that one of the reasons why women are not allowed to fight in the air is because they are considered too weak to stand up to the strain of air fighting. If this means that a woman could not stand the physical strain, I think I might say that if she can work hard for twelve hours a day, standing up, I think that she would be strong enough to fly any kind of aircraft. If, on the other hand, it means that she could not stand the mental strain, I think that it should be proved practically before jumping to such a conclusion; at any rate the Russian women have not found it too much for them.

Another point I must mention is that a great many girls already know the theory of flying, even of advanced aerodynamics, so is it not a waste of their knowledge not to give them the actual flying training which would turn them into what might easily be brilliant pilots? A. T. N. BLACKER.

FREIGHT TRANSPORT AIRCRAFT

Present and Post-war Needs

IT was with much interest that I read the comments made by *Flight*, dated August 6th, 1942, dealing with the important question of the moment, "Freight Transport Aircraft"—to be or not to be!

In these modern days of high-speed discussions, it would be old-fashioned to use the term "I told you so" after the much prophesised action had taken place, but it does now look as though all efforts are being made to close the stable door after the horse has bolted!

In your issue of February 13th, 1941, I drew attention to the fact that post-war freighters should be thought about and planned then, and not left until the war is over. If this had been done then, we should have been in a position to snap into instant action, now, in connection with the emergency that has arisen, and valuable assistance would have been forthcoming and no valuable time lost.

This question of adequate air transport and freighterage is by no means new, and has been a problem too easily pushed on one side in the hope that it would come round all right somehow without too much trouble. But, alas, it cannot and will not be dismissed so lightly, and has now grown to such an extent that it is one of paramount importance to the war effort.

So, please, now that those expert exponents of high-speed mass production, the Americans, have announced their intentions of providing the Allies with this much-needed transport fleet of the air, let us show some enthusiasm; it is the least we can do towards the plan.

I am quite sure that the mass shipbuilding expert, Mr. Kaiser, means to get results and, given the chance, will get these aircraft produced in double quick time and in considerable quantities.

The query arising out of the fact that to build these ships may hold back supplies needed for combat aircraft need not prove troublesome. We can afford to give precedence to the freighters, because we are not in desperate straits in regard to our bomber and fighter strength; many months ago we were informed that we had reached and passed the Axis air strength and output.

If England is to become the jumping-off ground for mighty bombing fleets, we must have a vast quantity of stores here to maintain these fleets; it is no use to us if the quantity of aircraft in this country is large, but owing to lack of supplies they cannot be serviced. This is a war of supplies, and the side that can get supplies rapidly to the place in which they are most needed will win. We must have learned this, to our cost, by now, from the results of air transport and freighterage as applied to warfare by the Germans. Speed is the king now—speed of supplies, speed of production, speed of distribution and speed of strategy.

The building and operation of air freighters should not all be left to the Americans—let us show our maximum effort in this sphere. We have the experience and the ideas, let them be brought out into the open and put to the test. What has happened to the Fairey "F.C.1" programme and the Shorts' programme? Are we going to let all the accumulated effort go to waste? This will not be just a wartime mushroom scheme; the air freighter is here to stay and will play an all-important part in after-war commercial plans. Why not do two jobs at once, now—prepare to win and, after, prepare to hold the peace that has been won.

So let us all put every effort we can muster into this so important task that is demanding instantaneous attention, and let action, and not criticism, hold sway.

KENNETH S. BELCHER.

BOOK REVIEWS

The High Courts of Heaven. By J. V. Hewes. Peter Davies, 7s. 6d.

MOST books concerned with the Battle of Britain or with air fighting in general strike a cheerful note, but this one is distinctly depressing. It lays most stress on the casualties and the sorrow felt by the survivors for those who have fallen on the field of honour. The author starts with four imaginary heroes, friends, and gradually kills them all off.

The book shows a certain amount of intimate knowledge of the doings of a fighter station and a good knowledge of the geography of Kent, but the author never seems clear about the difference between a flight and a squadron, and he constantly writes "aircraftsman" instead of "aircraftman."

"Air Navigation Plotting." By Mansel Williams, M.A., B.Sc. G. Bell and Sons, Ltd. 2s. 6d.

FLIGHT has previously commented upon the veritable spate of books which instruct the reader in the gentle art of finding one's way about in the air. Such books invariably begin by giving the gen about maps, and plots much the same course through the subject of navigation in general. This one, however, is different, for it assumes that the cadet already knows something about, for example, variation and deviation and, as navigation can only really be learnt by *doing* it, provides a series of examples to give him practical experience and to convert the isolated facts he has acquired into a method of navigation which will become a part of him and be permanently retained. "One-third lecture and two-thirds exercise is an excellent guiding principle for the average navigation lesson," says the author, and his book is a model of that.

"Drawing the R.A.F." By Eric Kennington. Oxford University Press. 12s. 6d.

ADMIRERS of this celebrated war artist's work will treasure a book of 52 portraits (four of which are reproduced in colour) of R.A.F. personnel whose courage, skill and devotion to duty during the present war has earned the admiration and gratitude of us all.

Several of his portraits have from time to time been reproduced in *Flight* and tribute paid to the almost uncanny manner in which his pastels capture the essential characteristics of his subjects, for there is a vigour and an "aliveness" about the Kennington portraits which give them an altogether exceptional quality.

The book has an admirable introduction by Sir Ronald Storrs, who outlines his career and deals fascinatingly with his meeting during the 1914-18 war with T. E. Lawrence, whose friend he became and for whose portrait he became known. Incidentally, it is a point of interest that years before then, in his very early days as an artist, Eric Kennington drew illustrations for *Flight's* associate journal, *The Motor Cycle*. But, as Sir Ronald Storrs says, he "providentially failed to earn his living as a black-and-white artist in the City."

With hook and flaps down a Fairey Fulmar eight-gun fighter lands on the steel deck of an aircraft carrier. This photograph was taken during the combined operations at Madagascar.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations:—

BAR TO THE DISTINGUISHED SERVICE ORDER.

Act. Wing Cdr. J. H. MARKS, D.S.O., D.F.C., No. 35 Sqn.—One night in April, 1942, this officer led an attack on the German Naval Base at Trondheim. Although well aware of the heavy defences concentrated in the target area, Wing Cdr. Marks dived down to 200 feet and, defying a fierce barrage, released his bombs over the objective. A month previously he took part in an attack on the same objective. This officer is a born leader who, by his splendid example, superb courage and determination to achieve success, greatly inspired other crews of his squadron who took part in the attack.

DISTINGUISHED SERVICE ORDER.

Wing Cdr. J. FULTON, D.F.C., A.F.C., R.A.F.O., No. 419 (R.C.A.F.) Sqn.—This officer has participated in attacks on industrial targets, dockyard towns, airfields and other important enemy targets. On one night in April, 1942, he successfully attacked Kiel. On the return journey his aircraft was attacked by an enemy fighter whilst flying at a height of 1,500 feet. Wing Cdr. Fulton's aircraft sustained much damage. One blade of the port propeller was shot away, the rear turret completely shattered, and the rear gunner wounded. The hydraulic system was damaged and many of the aircraft's instruments were rendered unserviceable. The damaged propeller caused intense vibration.

To offset this, Wing Cdr. Fulton decided to continue the journey on one engine. The aircraft would not maintain height, however, and descended to some 20 feet above the level of the sea. Wing. Cdr. Fulton was compelled to restart the port engine, and he succeeded in regaining height. The vibration recommenced and continued in an alarming manner until base was reached, where an excellent landing was made with the undercarriage retracted. This officer's skill and determination was responsible for the safe return of his damaged aircraft and its crew after a hazardous flight of some 1,18 miles after the aircraft had been attacked.

Wing Cdr. M. F. D. WILLIAMS, No. 42 Sqn.—During the time this officer commanded No. 42 Squadron he was responsible for raising it to a high standard of operational efficiency. On the night of May 17th, 1942, he led a force comprising Beauforts, Hudsons, Blenheims and Beaufighters in an attack on the *Prinz Eugen*. Despite intense defensive fire from the cruiser and four escorting destroyers, Wing. Cdr. Williams led his force into the attack with great courage and determination. Unfortunately, he was shot down during the engagement and is a prisoner of war. He always displayed inspiring leadership.

Sqn. Ldr. P. C. LEMON, D.F.C., No. 12 Sqn.—This officer has attacked targets in Germany, France, the Low Countries, Italy, Libya, Albania, Bulgaria, Iraq and the Dodecanese. He is a skilful and determined pilot who, both by his deeds and force of character, has inspired all who work with him. Sqn. Ldr. Lemon, when attacking Mannheim on one occasion, under very difficult conditions, displayed great care and persistence in identifying and bombing the objective. By his exceptional fearlessness, skill and determination, this officer has set a most inspiring example.

Act. Sqn. Ldr. A. E. HILL, D.F.C., R.A.F.V.R.—Sqn. Ldr. Hill has commanded a flight for a year. Both his flight and squadron have achieved outstanding successes which can be attributed to this officer's magnificent leadership and skill. His untiring efforts have inspired his fellow pilots.

BAR TO THE DISTINGUISHED FLYING CROSS.

Act. Wing. Cdr. T. O. FREEMAN, D.S.O., D.F.C., R.N.Z.A.F., No. 115 Sqn.—This officer has completed further sorties, including attacks on Essen, Lubeck, the Ruhr and Rostock. One night in May, 1942, he led his squadron on an attack against the aircraft factory at Warnemunde. Despite large concentrations of light anti-aircraft fire and searchlights he made six bombing attacks from a very low altitude in order to ensure accuracy of bombing. He succeeded in obtaining a

Wing Cdr. E. P. Wells, D.F.C. and Bar, of the Royal New Zealand Air Force, who has been awarded the D.S.O.

SERVICE AVIATION

photograph of the results. His aircraft was hit and damaged by the enemy's ground fire and on the return journey one engine failed whilst 100 miles from his base. By sheer determination and good airmanship Wing Cdr. Freeman succeeded in flying safely to base.

On another recent occasion he made attacks on Essen from a very low altitude against intensive opposition, making at least three separate runs on to the target area, and obtained photographs of the target. Throughout his operational career this officer has proved himself to be a courageous and outstanding leader who has inspired his squadron with that *esprit de corps* that is so necessary to success.

Sqn. Ldr. D. J. H. Lay, D.F.C., R.A.F.O., No. 7 Sqn.—Since July, 1941, this officer has participated in numerous attacks on a wide variety of enemy targets, including objectives at Hanover, Turin, Stettin, Brest and Rostock. He is a skilful pilot and captain who has carried out his attacks with great determination, often in the face of fierce opposition. On one occasion his aircraft was so badly damaged by enemy action that his rear gunner abandoned it by parachute, but despite this Sqn. Ldr. Lay flew his aircraft back to this country.

Distinguished Flying Cross.

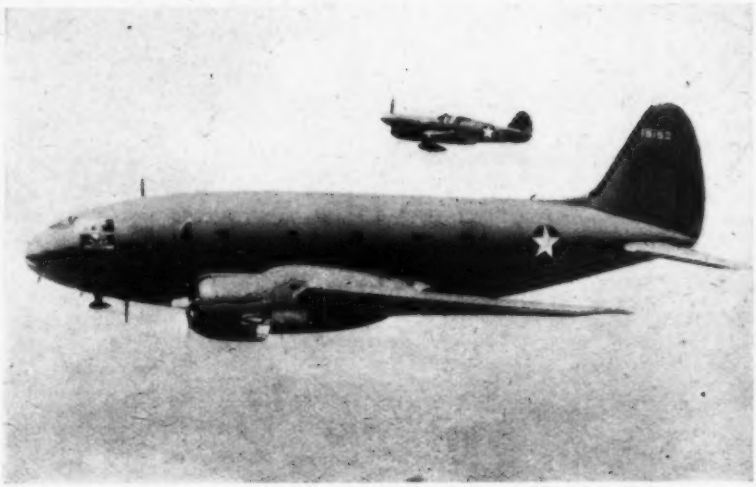
Act. Wing Cdr. J. E. Fauquier, R.C.A.F., No. 405 (R.C.A.F.) Sqn.—Throughout the many sorties in which he has participated, this officer has displayed the highest qualities of courage and leadership. His ability and grim determination to inflict the maximum damage on the enemy have won the admiration of the squadron he commands. Wing Cdr. Fauquier personally led his squadron on the two "thousand bomber" raids and then again went out on an operation on the following night, despite physical and mental fatigue after organising and leading the two previous operations. This officer is a born leader.

Sqn. Ldr. R. W. Turner, No. 9 Sqn.—Sqn. Ldr. Turner is not only a very efficient flight commander but is also an ideal type of heavy bomber captain. Before his sorties he organises his crew with scrupulous care and on this fact, together with the skill and determination he displays, rests the success with which all his tasks have been completed. He has participated in attacks on enemy industrial centres, dockyard towns, and completed many daylight North Sea sweeps. During his first operational tour of duty he completed a number of sorties involving anti-submarine sweeps and daylight attacks on enemy shipping in the Heligoland Bight and in the Norwegian area. He also took part in attacks on German troops, airfields and lines of communication in France and the Low Countries prior to the capitulation of France. Throughout his operational career he has displayed great devotion to duty. Only on three occasions has he returned without completing his task; technical failure of equipment has been the cause in each case.

P/O. P. F. R. Graham, R.A.F.V.R., No. 217 Sqn. (deceased), awarded with effect from August 15th, 1941.—This officer has displayed a fine fighting spirit and a high standard of morale in his attacks on enemy shipping. One day in June, 1941, off the French coast, two heavily armed vessels were attacked from a low altitude. A few weeks later he attacked a large-sized enemy ship from a low level, after the fighter escort of three Me's had been evaded. Although the attack was unsuccessful, due to bomb release failure, the pilot showed great courage in the circumstances. On the same sortie, a medium sized ship was attacked and hit. Despite heavy defensive fire from an escorting vessel, photographs of the burning ship were obtained. One night in August, 1941, a large merchant vessel, lying in harbour, was attacked from a low level. At least two hits were obtained. This officer has displayed great dash and determination throughout.

Act. Flt. Lt. T. P. K. Scade, R.A.F.V.R., No. 73 Sqn.—This fighter pilot has displayed high courage and skill which have been a splendid example to all personnel of his squadron. He has figured prominently in a number of hazardous operations in which he has shown a keen desire to engage the enemy. Flt. Lt. Scade has destroyed several enemy aircraft, of which two were destroyed on the ground during a particularly successful raid on Jedabya airfield.

Act. Flt. Lt. W. W. Swinnerton, R.A.F.V.R., No. 250 Sqn.—Flt. Lt. Swinnerton has completed a large number of operational flying hours over the Western Desert and has carried out many operational sorties. In November, 1941, he was shot down near Benina airfield. Hiding himself, he watched the enemy lay a minefield before they withdrew. He then made a map which enabled our forces, on their arrival, to render the airfield serviceable at once. In May, 1942, when proceeding on a flight to machine-gun the enemy, he observed six of his comrades walking. Flt. Lt. Swinnerton landed near them and, finding that they were the crew of an aircraft which had been shot down, he gave them his emergency rations, after which he took off and directed one of our patrols to their rescue.



One of the Curtiss (C.46) Commando twin-engined transporter aircraft in production for the U.S. Army Air Forces. In the background is a Merlin-engined Warhawk with long-range tank fitted under the fuselage.

Lt. W. J. S. A. Webb, S.A.A.F., No. 40 (S.A.A.F.) Sqn.—In May, 1942, whilst on a reconnaissance flight, this officer was engaged by three enemy aircraft, one of which he destroyed. He then continued his reconnaissance and gained valuable information. Shortly afterwards Lt. Webb's aircraft was shot down in flames, but, displaying great courage and initative, he avoided capture and returned to his squadron. He has at all times displayed great skill and devotion to duty which have contributed largely to the high standard of morale maintained by his squadron.

Act. F/O. L. P. S. Bing, R.C.A.F., No. 89 Sqn.—F/O. Bing has displayed courage and outstanding skill. He has taken part in the destruction of ten enemy aircraft at night. F/O. Bing has set a magnificent example to other observers.

P/O. A. J. Hancock, R.A.F.V.R., No. 213 Sqn.—This officer has shot down five enemy aircraft and damaged a further two during recent operations in the Western Desert. In a combat in June, 1942, P/O. Hancock sustained a bullet wound in the arm. Despite the intense pain and the loss of much blood, he flew his aircraft to the nearest landing ground and, although in a semi-conscious condition, made a perfect landing.

P/O. G. Stenborg, R.N.Z.A.F., No. 185 Sqn.—P/O. Stenborg has displayed great determination and keenness to engage the enemy. One day in July, 1942, he encountered a superior force of enemy fighters which were acting as escort to bombers. P/O. Stenborg attacked the enemy fighters, destroying two of them, and dispersed the remainder, thus enabling other R.A.F. fighters to attack the bombers. A few days later he completed a similar operation and again shot down two enemy fighters. P/O. Stenborg has now destroyed eight enemy aircraft.

Act. Sqn. Ldr. F. H. Robertson, No. 106 Sqn.—Sqn. Ldr. Robertson has completed sorties, including attacks on aircraft works at Rostock and Warnemunde, which were carried out in the face of intense defensive fire and searchlight activity. Sqn. Ldr. Robertson is commanding a flight with conspicuous success, while the performance of his ground duties is beyond reproach.

Flt. Lt. J. V. Watts, R.C.A.F., No. 10 Sqn.—This officer is a courageous and highly skilled navigator who has done much to ensure the success of many of the sorties in which he has participated. One night in April, 1942, he was the navigator of an aircraft detailed to attack the German naval base at Trondheim. On arrival at the target area the aircraft was intercepted by an enemy fighter, but Flt. Lt. Watts coolly and skilfully guided his captain down through an intense barrage and the fighter was unable to follow. The objective was then attacked from an extremely low level. The following night, when attacking the same objective, Flt. Lt. Watts distinguished himself by his brilliant navigation.

Act. Flt. Lt. H. S. Blakeman, D.F.M., No. 97 Sqn.—Flt. Lt. Blakeman has taken part in attacks on targets of major importance, including three raids on Berlin, three on Kiel, and others in the Ruhr area. He also took part in a daylight attack on Brest. Throughout, this officer has set a high standard of discipline, skill and determination.

Act. Flt. Lt. A. P. Dart, R.A.F.V.R., No. 420 (R.C.A.F.) Sqn.—This officer has completed a number of sorties, including bombing and mine-laying missions. Throughout his operational career, Flt. Lt. Dart has participated in attacks against most of the highly defended and important enemy targets. He is a skilful pilot, and is held in high esteem by all air crews of the squadron.

The bomb-aimer in a Short Stirling about to press the switch which releases the bombs which have been preselected and fused.

SERVICE AVIATION

Act. Flt. Lt. C. S. DOWIE, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—This officer has completed a large number of sorties, involving attacks on targets both in Germany and German-occupied territory. He is a skilful and determined pilot, who has achieved success against heavily defended targets. His courage in the face of enemy fire has set an inspiring example.

Act. Flt. Lt. T. W. G. GODFREY, R.A.F.V.R., No. 10 Sqn.—On a night in April, 1942, Flt. Lt. Godfrey was detailed to participate in a low-level bombing attack on the German naval base at Trondheim. Over the target area his aircraft was intercepted by an enemy fighter. Coolly diving straight down through an intense barrage, Flt. Lt. Godfrey evaded the attacker. He then carried out an attack right across the target from an extremely low height. The attack was repeated the following night, and his bombs once more straddled the target. Flt. Lt. Godfrey has displayed considerable dash and enthusiasm when attacking his allotted target. He has several times earned praise for securing excellent photographs. He is an outstanding pilot.

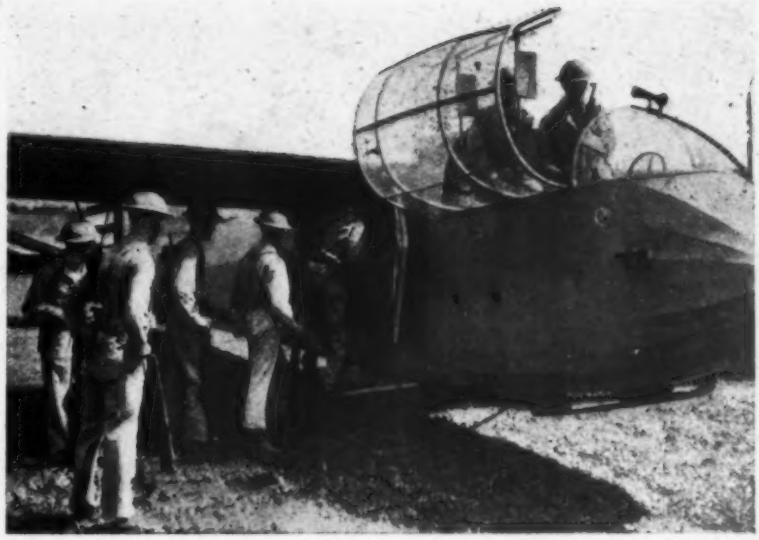
Act. Flt. Lt. T. W. HORTON, R.N.Z.A.F., No. 88 Sqn.—Flt. Lt. Horton has successfully completed a number of shipping patrols, also other operations, including the brilliant low-level attack against shipping in Rotterdam on the 28th August, 1941. Throughout, this excellent captain has displayed courage, resource and skill high above the average. His aircraft has been repeatedly hit and damaged by anti-aircraft fire, and, on no fewer than three occasions, he has brought his aircraft safely back to base after having had one engine rendered useless by enemy action.

F/O. R. J. HARDINGHAM, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—F/O. Hardingham has participated in numerous sorties, many of them penetrating deep into enemy territory and often in bad weather. These sorties include repeated attacks on targets at Kiel, Essen, Hamburg, Cologne and Mannheim. He participated in an attack on the *Scharnhorst* during the battleship's escape from Brest. Whilst attacking from a height of 500 feet, F/O. Hardingham's aircraft was extensively damaged by anti-aircraft fire. Although his cockpit was wrecked and his maps and instruments mutilated, his subsequent navigation was largely responsible for the safe return of his aircraft. As squadron navigation officer, F/O. Hardingham has been a source of encouragement and inspiration to inexperienced navigators.

F/O. I. MAITLAND, R.A.F.V.R., No. 408 (R.C.A.F.) Sqn.—This officer has participated in many sorties, many of them against targets deep in enemy territory. He has taken part in repeated attacks on Rostock and such heavily defended areas as Kiel, Hamburg, Essen, Huls and other targets in the Ruhr. As wireless operator, F/O. Maitland has rendered valuable service in assisting in the safe return of his aircraft in bad weather.

During an attack on Huls in October, 1941, his aircraft was attacked by three enemy fighters, but F/O. Maitland's vigilance and skilful directions enabled his captain to out-manœuvre the attackers. On a number of occasions he has extinguished, by machine-gun fire, concentrations of searchlights which were holding his aircraft. Twice at Rostock, from a height of a few hundred feet, he shot up the airfield adjoining the Heinkel works and set a number of buildings on fire. His courage and efficiency as squadron gunnery officer have had a beneficial effect upon the standard of gunnery of the squadron.

Col. Victorovitch Tashin of the Russian Air Force inspecting a North American (B.25) Mitchell.



The U.S. Army is training a huge number of airborne troops. In this photograph shock troops are seen embarking on a eight-man glider.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. E. T. BORSBERRY, No. 76 Sqn.—Flt. Sgt. Borsberry, as captain of aircraft, has participated in many sorties over enemy territory, including attacks on targets in Berlin, Kiel, Bremen, Cologne, and on the German naval base at Trondheim. He is a courageous and skilful pilot.

Flt. Sgt. H. BURKE, No. 138 Sqn.—This wireless operator-air gunner participated in many long-distance operations, and by his skill as a wireless operator Flt. Sgt. Burke has provided valuable assistance to his navigator in adverse weather. On one return journey, although the wireless set was partly unserviceable, he enabled his captain to land successfully in spite of bad visibility.

Flt. Sgt. J. M. COSTAIN, No. 101 Sqn.—Flt. Sgt. Costain is a first class wireless operator of wide experience and has participated in many successful night raids over enemy territory.

Flt. Sgt. C. E. DARBY, R.C.A.F., No. 10 Sqn.—On his last sortie, Flt. Sgt. Darby was the navigator of an aircraft detailed to attack the German naval base at Trondheim. Whilst over the target area, the aircraft was subjected to an intense barrage of anti-aircraft fire. Despite this, the objective was attacked from only 150 feet. As a result of the terrific enemy fire, the aircraft was damaged in several places. Flt. Sgt. Darby's skilful navigation contributed materially to the success of this hazardous operation. This airman is a courageous and determined observer whose fine fighting spirit has set an excellent example.

Flt. Sgt. (now W/O.) T. H. DONNELLY, No. 57 Sqn.—As captain of aircraft Flt. Sgt. Donnelly has carried out many successful sorties over enemy and enemy occupied territory, including targets at Essen, Kiel, Cologne, Hamburg and Brest. Many of these bombing attacks have been carried out at below 10,000 feet and in adverse weather. He has often remained in the target area for long periods, making several runs over the target to ensure accuracy of his bombing. On several occasions Flt. Sgt. Donnelly's aircraft has been damaged by enemy anti-aircraft fire, but he has at all times pressed home his attacks with vigour, and by his skill and determination he has succeeded in flying back to base safely.

Flt. Sgt. E. C. GLENWRIGHT.—Flt. Sgt. Glenwright has participated in many successful sorties over enemy territory. Since October, 1941, he has held the appointment of W/T. Instructor. As a wireless operator he displayed great skill and coolness during his long period of operational flying.

Flt. Sgt. A. D. HOWE, No. 88 Sqn.—Flt. Sgt. Howe has completed a number of successful shipping patrols off the Irish coast and has participated in intensive daylight operations carried out in the summer and autumn of 1941, including the brilliant attack on August 28th, 1941, against shipping in Rotterdam. Since then, Flt. Sgt. Howe has completed further successful operational sorties. He is a courageous and highly efficient wireless operator-air gunner, who has displayed coolness and determination in the face of danger.

Flt. Sgt. (now P/O.) A. W. RATBOULD, No. 101 Sqn.—This airman has participated in many successful sorties over Germany and German occupied territory. As captain of aircraft he has proved himself keen and determined in pressing home his attacks.

Flt. Sgt. (now P/O.) C. A. ROBSON, R.C.A.F., No. 419 (R.C.A.F.) Sqn.—Flt. Sgt. Robson, as wireless operator, participated in many important attacks on docks and industrial targets in enemy and enemy-occupied territory.

Flt. Sgt. R. J. L. SAWYERS, R.A.F.V.R., No. 35 Sqn.—Flt. Sgt. Sawyers has participated in many sorties including attacks on targets in Berlin, Turin, Mannheim and the Ruhr. On all these long-distance flights, regardless of the weather or enemy opposition, he has never failed to obtain all the necessary wireless information to which, to a great extent, the safe return of his crew can be attributed. He has a fine operational record and sets a splendid example of courageous devotion to duty.

Sgt. A. W. BARKER, R.A.F.V.R., No. 207 Sqn.—As wireless operator-air gunner Sgt. Barker has participated in many successful sorties against docks and industrial targets in enemy territory, including attacks on Kiel, Hamburg, Lorient, Rostock and Wilhelmshaven. His efficiency and keenness have contributed largely to the success of these operations and provided an excellent example to other wireless operator-air gunners in the squadron.

Sgt. J. W. H. HARWOOD, No. 76 Sqn.—Sgt. Harwood has completed many sorties over enemy territory, including attacks on Berlin, Hamburg, Hanover and Bremen. Throughout his career as a captain he has shown great keenness and unfailing courage. Three times he has returned from operations with his aircraft badly damaged and twice he has been forced down into the sea. Nevertheless his courage and determination are undaunted.

Sgt. G. C. JOHN, No. 103 Sqn.—As captain of aircraft this airman has participated in many night operations against the enemy. He has often attacked heavily defended targets from low level to ensure accuracy. On one occasion, he attacked the searchlights at Warnemunde from a height of only 200 feet, despite intense anti-aircraft fire and searchlight activity.

One night in March, 1942, in an attack on Essen, his aircraft was badly damaged by anti-aircraft fire, which rendered the hydraulic system unserviceable and holed the petrol tanks. Although forced down to 1,000ft. Sgt. John skilfully evaded further damage until nearing the English coast, when the engines failed owing to lack of petrol. With great judgment Sgt. John decided to alight in the sea rather than to land on the beach. This he carried out most successfully despite the fact that the flaps were unserviceable and the undercarriage was hanging down. The crew were rescued thirteen hours later.

Sgt. R. E. V. PUGH, No. 103 Sqn.—This airman, as captain of aircraft, has participated in many raids on enemy territory. When returning from a raid on the Ruhr, his aircraft was badly damaged by an enemy night fighter. The hydraulics were shot through causing the under carriage to drop and the bomb doors to fall open. Despite this, his successful handling of the aircraft enabled the rear gunner to fire a burst and drive off the attacker. Sgt. Pugh then successfully returned to base and made a safe landing with the undercarriage retracted.

Sgt. L. S. THORPE, No. 35 Sqn.—This wireless operator/air gunner has participated in many sorties over Germany and German occupied territory, including attacks on targets at Hamburg, Berlin, Cologne and the Ruhr. On the nights of

SERVICE AVIATION

April 27 and 28, 1942, Sgt. Thorpe participated in an attack on the German naval base at Trondheim. These flights each involved a total flying time of more than nine hours and covered a distance of well over 1,360 miles over the North Sea and the mountainous country of Northern Norway. He also participated in the daylight raids on the German battleships *Gneisenau* and *Scharnhorst* at Brest. Regardless of enemy opposition and bad weather, Sgt. Thorpe has never failed to produce necessary wireless information, which contributed much to the safe return of the aircraft.

Sgt. P. F. WOOLLAND, No. 142 Sqn.—Sgt. Woolland carries out his duties as captain with efficiency and determination. He also displays great skill in night photography and has taken valuable photographs of enemy territory. He possesses a fine fighting spirit and presses home his attacks regardless of enemy opposition and technical difficulties. On one occasion he had engine trouble when on the outward journey to attack a target in the Baltic. Nevertheless, he carried on and fulfilled his mission.

Flt. Sgt. T. O. McILQUHAN, R.C.A.F., No. 102 Sqn.—One night in May this airman was the rear gunner of an aircraft detailed to attack Cologne. Whilst flying at a height of 9,000 feet his aircraft was attacked by a F.-W.190. Flt. Sgt. McIlquhan waited until the fighter was within short range and then opened fire. Upon a second attack being made, he fired a long burst, which sent the enemy aircraft spinning to the ground. Later the same night, Flt. Sgt. McIlquhan destroyed another F.-W.190.

One night in June he was rear gunner of a bomber detailed to attack Bremen. His aircraft was attacked by a Me.109. He fired two bursts and the enemy aircraft broke away and fell out of control with the engine on fire. Flt. Sgt. McIlquhan is a cool and skilful air gunner, whose courage and determination are an inspiration to his squadron.

Flt. Sgt. P. A. SCHADE, No. 126 Sqn.—This airman has always shown the greatest keenness to engage the enemy. He has destroyed at least eleven hostile aircraft. On three occasions he destroyed two aircraft in one sortie. By his zeal and courage he has set a magnificent example to the squadron.

AWARD OF A FOREIGN DECORATION. ROYAL AUSTRALIAN AIR FORCE.

THE KING has granted unrestricted permission for the wearing of the undermentioned decoration, conferred in recognition of valuable services rendered in connection with the war:—

CONFERRED BY THE PRESIDENT OF THE POLISH REPUBLIC.

Krzyz Walecznych (Croix des Vaillants).
Flt. Lt. C. R. CALDWELL, D.F.C.

Roll of Honour

Casualty Communique No. 146.

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Royal Air Force

KILLED IN ACTION.—P/O. M. L. Bowley; Sgt. S. W. F. Leigh; Sgt. J. D. Paulich; P/O. C. Scathard; Sgt. R. F. Shaddick.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. J. H. Addis; Sgt. E. A. Bailey; Sgt. A. W. Baker; P/O. A. W. Buchan; F/O. P. S. Charles; Flt. Sgt. J. G. Clelland; P/O. A. G. W. Debonnaire; Sgt. C. G. Furby; Sgt. J. S. Gray; P/O. J. R. Hubbard; Flt. Sgt. G. E. Jones; Sgt. G. T. Leather; Flt. Sgt. F. R. Lewis; Sgt. S. Lockett; Sgt. H. J. McHutchinson; Sgt. G. P. Murray; Sgt. E. Owen; Sgt. J. E. Smart; Sgt. K. W. Smith; Sgt. H. Taylor; P/O. H. Taylor; Sgt. J. H. Watkinson; Sgt. H. J. Whale; Sgt G. Williams.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. Flt. Lt. J. J. F. H. Bandinel; Act. Sqn. Ldr. T. Grier, D.F.C.; P/O. D. Jacobs; Sgt. J. J. Lammin; Sgt. R. M. D. McLeod; Sgt. J. Marsland; Sgt. C. E. Newman; Act. Flt. Lt. G. Peiling; Sgt. A. C. Shorey; P/O. D. L. Skinner, D.F.C.; Sgt. W. Smithson; P/O. J. H. Strong, D.F.M.; Sgt. D. K. Taylor; Sgt. V. E. Towers; Act. Flt. Lt. O. V. Tracey; Sgt. J. H. Walker.

WOUNDED OR INJURED IN ACTION.—Group Capt. R. L. R. Atcherley, O.B.E., A.F.C.; P/O. A. B. Cuddon; Sgt. P. J. Georges; Flt. Lt. J. C. Paish.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—F/O. J. B. Kendal.

MISSING, BELIEVED KILLED IN ACTION.—Act. Flt. Lt. J. W. Buckstone; Sgt. S. Cox; Flt. Sgt. R. W. A. Hawkesworth; Sgt. E. Mason; Sgt. R. P. Moore; P/O. A. R. Simpson; Flt. Sgt. V. A. Willetts.

MISSING.—Sgt. W. Agar; P/O. F. H. J. Ashton; P/O. R. Beaumont; Flt. Sgt. R. H. Black; Sgt. A. F. Blencowe; Sqn. Ldr. K. D. Bruce; Sgt. H. B. Bullen; Sgt. C. J. E. Butler; Sqn. Ldr. J. C. Carver, D.F.C.; Sgt. J. C. Clark; Flt. Sgt. F. W. Cooper; P/O. J. L. Crisp; P/O. W. Culmsee; Act. F/O. L. N. W. Dobson; P/O. I. P. Duxbury; Sgt. F. O'K. Eivers; Sgt. A. G. Ennis; P/O. W. K. Ford; Sgt. T. J. Francis; P/O. W. Glenn; Flt. Sgt. N. Gordon; F/O. K. C. Gundry; P/O. D. A. Hamilton; Sgt. S. H. Harle; Flt. Lt. C. W. Harper, D.F.C.; Sgt. H. E. Hothersall; Flt. Sgt. M. M. Irvine; P/O. E. R. Johnson; Flt. Sgt. R. Johnson; P/O. H. S. Keeton; P/O. W. D. Kennard; Sgt. J. Moores; Sgt. A. W. Munro; Sgt. D. W. Musgrove; Sgt. E. R. C. Oakley; Sgt. R. S. Oliver; P/O. A. E. Parsons; Act. F/O. L. J. Pinion; P/O. A. G. Powell; Sgt. T. H. Power; P/O. J. H. Reid; Sgt. R. Robertson; Sgt. W. V. Rogerson; P/O. N. W. Rowell; Sgt. J. Salmon; Sgt. W. G. Sherratt; Sgt. J. Smith; Sgt. G. Stephenson; Sgt. D. N. Storer; Sgt. K. Taylor; Sgt. R. Thompson-Horan; Sgt. V. G. F. Walklin; F/O. G. W. Ward; Sgt. P. L. Wheeldon; Sgt. D. Wightman; P/O. P. P. Wilson; Sgt. J. E. Wood.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. E. W. J. Blake; Sgt. N. W. Callister.

KILLED ON ACTIVE SERVICE.—Sgt. H. L. Allen; Sgt. J. H. Bingham; Sgt. R. H. Bircher; Cpl. C. J. Campbell; F/O. H. C. Carpenter; Flt. Sgt. A. F. Chadwick; F/O. M. O. Davenport; Sgt. E. A. Doughty; P/O. E. J. Escourt-Watkins; Sgt. J. B. F. Fanning; Sgt. M. C. Glover; Sgt. K. C. Golding; P/O. J. Hemingway; Flt. Lt. R. W. G. Holdsworth; L.A/C. E. R. N. Jones; Act. Flt. Lt. J. O. D. Kellow; Flt. Sgt. B. F. Kilian; P/O. F. Leece; Flt. Lt. A. D. Livingstone; Sgt. R. D. MacGregor; Act. Sgt. C. A. McNabb; Sgt. F. R. Magson; Act. Sgt. R. Martin; L.A/C. A. S. Mitchell; Sgt. E. McM. Mutch; L.A/C. M. Preston; Sgt. J. C. W. Sealey; Wing Cdr. R. G. Shaw; L.A/C. F. P. Skelly; L.A/C. A. E. Snelson; Sgt. R. C. Warkeup; L.A/C. J. Watson.

PREVIOUSLY REPORTED MISSING NOW PRESUMED KILLED ON ACTIVE SERVICE.—A/C.2 J. Cookson; A/C.2 D. J. Fellowes; Cpl. A. P. Fudge; A/C.2 E. J. D. Walton; A/C.2 J. Woodhead.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. C. A. K. Boyes; A/C.2 F. J. James; Sgt. W. A. Jones; P/O. N. G. Kirkland; P/O. E. G. Mather; Wing Cdr. P. W. Stansfield.

DIED ON ACTIVE SERVICE.—L.A/C. D. T. Arbuckle; A/C.1 R. H. J. Balchin; L.A/C. W. A. Clavey; A/C.1 W. J. Day; A/C.2 R. W. Douglas; A/C.1 F. H. Endean; Flt. Sgt. S. Goodfellow; P/O. R. M. Harris; Act. Wing Cdr. H. R. W. Hogg, C.I.E., O.B.E.; A/C.2 C. Hudson; A/C.1 T. V. McCormack; Cpl. G. D. Mitchell; A/C.1 E. Poupard; L.A/C. W. T. Pratt; P/O. A. H. B. C. Salaman; P/O. G. C. Smythe; Cpl. C. E. Thomas; A/C.1 A. Vella; A/C.1 I. W. Wakefield; A/C.1 P. C. Wakely; Cpl. C. E. Williams; A/C.2 A. J. Woodhouse.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. I. I. H. Laughton; P/O. C. W. P. Persse.

PREVIOUSLY REPORTED MISSING NOW PRESUMED KILLED IN ACTION.—Sgt. C. F. Lee; Sgt. E. M. Lindsay; P/O. T. K. Robinson; P/O. A. G. Sands.

WOUNDED OR INJURED IN ACTION.—P/O. B. J. McSharry.

MISSING.—Sgt. L. A. Beauchamp; Sgt. P. M. Benison; Sgt. A. L. Brandt; Sgt. R. J. Buckingham; P/O. K. F. Carson; P/O. C. C. Chataway; A/C.1 T. Dorney; Flt. Sgt. R. A. Drew; P/O. B. N. Gilbert; Sgt. A. N. Glancy; Sgt. R. W. Golder; P/O. J. B. Halbert; Flt. Lt. M. L. Judell; Sgt. H. J. Kevan; Sgt. K. F. Lloyd Jones; Sgt. J. V. McLean; Sgt. W. S. McQueen; Sgt. F. R. Martin; Sgt. H. Rogers; Sgt. R. G. M. Roget; Sgt. F. J. Ryan; P/O. E. R. Somerville; P/O. C. K. Tait; Sgt. E. J. Taylor; A/C.1 F. W. Tipping; L.A/C. R. G. Willis; Sgt. W. L. Winterflood.

KILLED ON ACTIVE SERVICE.—Sgt. J. W. Balfour.

Pigeon containers used by Coastal Command can be made watertight in case of emergency. After the container is sealed there is sufficient air to keep the bird alive for 30 minutes.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Sgt. W. J. E. Lines; P/O. I. A. Miller.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. J. R. Dow; P/O. R. Heggie; Flt. Sgt. F. J. Lowe; Sgt. W. C. Picher

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. Sqn. Ldr. J. D. Morrison.

WOUNDED OR INJURED IN ACTION.—Sgt. G. F. McHugh.

MISSING, BELIEVED KILLED IN ACTION.—P/O. R. B. Halliday; Sgt. R. M. Lawrence.

MISSING.—Act. Flt. Lt. T. H. Allen; Sgt. E. F. Bramley; Flt Sgt. C. L. Bray, D.F.M.; P/O. D. R. Florance; P/O. E. W. Gillespie; Act. W/O. T. W. Hare; Sgt. A. W. C. E. King; Sgt. E. H. Martin; Act. Flt. Lt. J. J. Mooney; Sgt. W. A. R. Moule.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. M. H. Roberts; P/O. A. L. St. Aubin.

DIED ON ACTIVE SERVICE.—Sgt. H. R. N. McCormick.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING—NOW PRESUMED KILLED IN ACTION.—Sgt. R. H. Haristone; Sgt. D. F. Streeter.

MISSING.—Flt Sgt. L. R. Feasey; P/O. K. F. Heald; P/O. W. L. Kauter; P/O. W. G. D. Thurston.

KILLED ON ACTIVE SERVICE.—Sgt. S. Alcock; P/O. A. W. Asmuss.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. D. A. Harkness; Sgt. E. J. Twigg.

DIED ON ACTIVE SERVICE.—P/O. J. G. Booklass.

South African Air Force

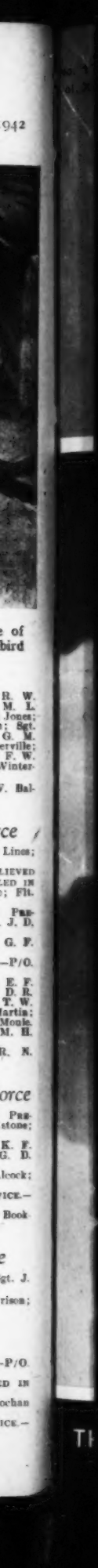
WOUNDED OR INJURED IN ACTION.—Air Sgt. J. Zylstra.

MISSING.—Lt. I. Brown; Lt. R. G. Harrison; 2nd Lt. D. H. Nichol.

Indian Air Force

WOUNDED OR INJURED IN ACTION.—P/O. Larive.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. Moses.

KILLED ON ACTIVE SERVICE.—P/O. Trilochan Singh.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. Aman Amir Qumaruzz.